Characterization of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzo-Furans Contaminants in Sediment of the Houston Ship Channel Between Morgan's Point and Galveston Island in Galveston Bay, Texas

EPA Project Number:
EP096000119

Prepared for:
U.S. Environmental Protection Agency
Region 6, Dallas, Texas

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations	Definition
ALS	ALS Laboratory Group
BESI	Benchmark Ecological Services, Inc.
CAS	Chemical Abstracts Service Registry
COC	Chain of Custody
DL	Detection Limit
ECS	Environmental Chemistry Services
EPA	U.S. Environmental Protection Agency
GPS	Global Positioning System
HSC	Houston Ship Channel
ITM	Inland Testing Manual
LFB	Laboratory Fortified Blank
LFM/D	Laboratory Fortified Matrix/Duplicate
MDL	Method Detection Limit
MPRSA	Marine Protection, Research, and Sanctuaries Act
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ND	Non Detect
NELAP	National Environmental Laboratory Accreditation Program
ND	Non-Detect
ODMDS	Ocean Dredged Material Disposal Site
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RIA	Regional Implementation Agreement
RPD	Relative Percent Difference
SMP	Site Management Plan
TCEQ	Texas Commission on Environmental Quality
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalency Quotient
TOC	Total Organic Carbon
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

To maintain safe shipping lanes through Galveston Bay, the U.S. Army Corps of Engineers (USACE) must periodically dredge accumulated sediment from the navigation channel. Sediment dredged from the Houston Ship Channel (HSC) segment that crosses Galveston Bay is usually deposited in an Ocean Dredged Material Disposal Site (ODMDS) located in the Gulf of Mexico east of Galveston Island. In 2003, the U.S. Environmental Protection Agency (EPA) and USACE developed a Regional Implementation Agreement (RIA) for Testing and Reporting Requirements for Ocean Disposal of Dredged Material off the Louisiana and Texas Coasts under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) (EPA/USACE, 2003). Under this agreement, the EPA has the responsibility for monitoring the impacts of dredged material disposal at the Galveston ODMDS. To prepare for future dredge events in the HSC and sediment disposal in the Galveston ODMDS and to fully comply with the provisions of the 2003 RIA, the EPA needs to characterize Dioxin and Furan contamination in the HSC segment between Morgan's Point and Galveston Island.

Benchmark Ecological Services, Inc. (BESI) was contracted by the EPA to conduct the Characterization of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzo-Furans Contaminants in Sediment of the Houston Ship Channel Between Morgan's Point and Galveston Island in Galveston Bay, Texas (EPA project number EP096000119). BESI conducted the study according the Sampling and Analysis Plan/Quality Assurance Project Plan dated August 14, 2009.

1.1 BACKGROUND

The MPRSA sets forth criteria for management and monitoring of EPA designated 102(c) ODMDS. The primary purpose of an ODMDS monitoring program is to evaluate the potential impact of dredged material disposal on the marine environment. The EPA and USACE are responsible for monitoring the impacts of dredged material disposal at the ODMDS.

In 1995 and 1996, the EPA performed background studies of the chemical and biological composition of several ODMDS in Texas and Louisiana to assist the agency in developing Site Management Plans (SMPs) for each (Battelle, 1996). Implementation of the requirements set forth in the SMPs has been ongoing and consists of bathymetric surveys of the disposal sites pre and post-disposal of dredged materials and periodic Tiered Evaluations of the "to be dredged material" to demonstrate disposal in the ODMDS will not cause environmental degradation or adversely effect human health. In 1996 and again in 2003, the EPA, Region 6 and both USACE District Offices in Galveston, Texas, and New Orleans, Louisiana, entered into a RIA (EPA/USACE, 2003). The RIA identifies the monitoring and testing procedures as required to comply with the MPRSA and adheres to the monitoring and testing manuals produced by the USACE and EPA for dredged material disposal called the Green Book (EPA/USACE, 1991) and the Inland Testing Manual (ITM) (EPA/USACE, 1998). The RIA contains a list of Contaminants of Concern identified for chemical sampling and analysis when required. The compound 2,3,7,8 tetrachloro dibenzo-p-dioxin (2,3,7,8 TCDD) and other polychlorinated dioxins and furans are not included in the list of Contaminants of Concern. This decision was based on the lack of appreciable concentrations in sediments monitored.

Within the last ten years, 2,3,7,8 TCDD has been detected in increasing concentrations within the upper HSC (Rifai, 2006). Through rigorous monitoring of the HSC in the segments 1005, 1006 and 1007 the Texas Commission on Environmental Quality (TCEQ) identified the source of the dioxin contaminants. TCEQ verified the source as a previously above ground hazardous waste site, which has subsequently subsided and now is submerged in the backwaters of the San Jacinto River near the confluence of the river and the HSC.

While dioxins have been intensively monitored in the HSC, the seaward monitoring within Galveston Bay has not been as thorough. In advance of dredging in the HSC between Morgan's Point and Galveston Island the extent of dioxin and furan contamination in channel sediments should be determined. Results of this study will be used to determine the distance dioxin contamination has migrated toward Galveston Island. Future dredging in the HSC for ocean disposal will be limited to areas without significant dioxin and furan contamination unless an appropriate characterization of the sediment, including polychlorinated dioxins and furans is performed prior to disposal, or another adequate contaminant management methodology is agreed to by the U.S. Army Corps of Engineers, Galveston District and U.S. Environmental Protection Agency, Region 6.

1.2 OBJECTIVES

This study was designed to provide the EPA and USACE with current information about the level of dioxin and furan contamination in HSC sediments between Morgan's Point and Galveston Island. The primary objective of this study was to collect representative samples of unconsolidated sediment from seven (7) stations in the HSC between Morgan's Point and Galveston Island, collect a representative sample from the Galveston Area ODMDS Reference Site, and to analyze the samples for specific polychlorinated dioxins and furans. The results of the chemical analyses were used to estimate a Toxicity Equivalency Quotient (TEQ) for each sample. TEQs for the HSC samples were compared to the TEQ for the ODMDS Reference Site Sample to predict the portion of the HSC (within the study area) that has TEQ values 20% greater than the TEQ of the Reference Site.

1.3 APPROACH

This study focused on contamination in recently accumulated (unconsolidated) sediments on the bottom of the HSC. A bathymetric survey was conducted at each of the seven HSC sample stations to ensure that samples were collected from sites on the bottom of the channel and not from the side slopes. Three samples were collected from a transect at each sample station and combined, to ensure that the samples were representative of sediment in that portion of the channel (EPA/USACE, 1998). The samples were analyzed for seven congeners of Dibenzo-p-Dioxin and ten congeners of Dibenzo-p-Furan, and the concentration of each congener in each sample was multiplied by an established Toxicity Equivalency Factor (TEF) (I-TEF/89) (NATO/CCMS, 1988a) (NATO/CCMS, 1988b) to produce a TEQ. The TEQ scheme was developed to express the total toxicity of mixtures of dioxins and furans (EPA, 1989). The TEQs from all stations in the HSC were compared to the TEQ calculated for background sediment from the Galveston ODMDS Reference Site. A mathematical equation was used to estimate the

portion of the sediment in the HSC, south of Morgan's Point that has a TEQ 20% greater than the Reference Site TEQ.

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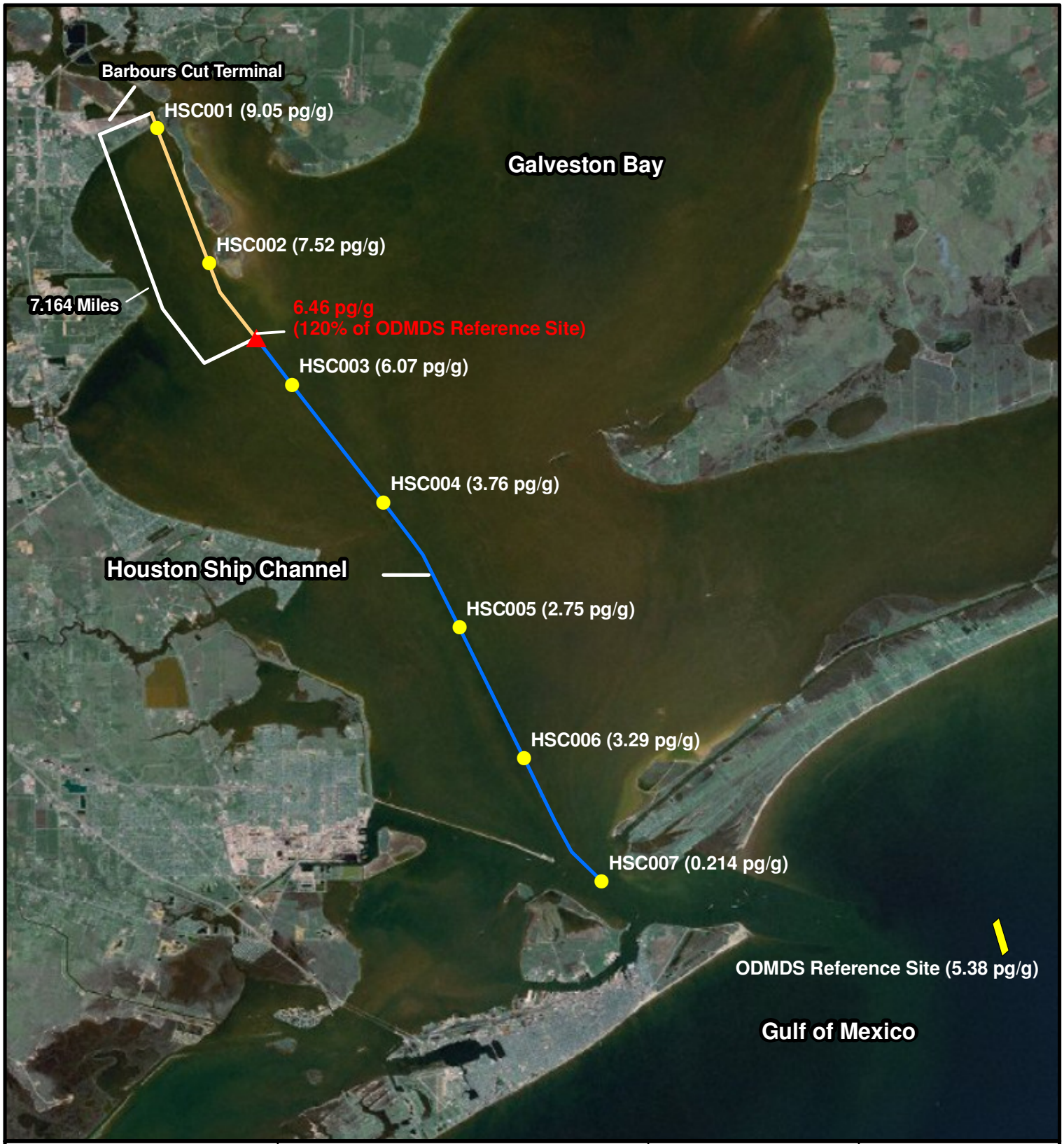
2.0 METHODS AND MATERIALS

2.1 SAMPLE STATION LOCATION

Seven sample stations were established on the centerline of the HSC between Morgan's Point and Galveston Island (25.1 miles) in accordance with the procedures described in the *Bathymetric Survey Report* provided in Appendix A of this document. The northern-most station was established at the southern tip of Morgan's Point and southern-most station was established north of where the HSC enters the Bolivar Roads Channel near Galveston Island (Figure 1).

The following is a summary of the station selection process utilized for this study. At each proposed station, a boat equipped with a Global Positioning System (GPS) and depth recording sonar was used to simultaneously record geographic coordinates and water depth along an east/west transect that passed through the proposed station. As the survey boat motored across the HSC on each transect, water depth and coordinates were recorded at 50-foot intervals in the GPS and on Survey Data Sheets. A cross-section of the channel was generated, and the transition between channel bottom and side-slopes was identified. A point midway between the side-slopes was selected as the primary sample station. A secondary sample site was established on either side of the primary station, between the primary station and the side-slope. All three sample sites (primary sample station and two secondary sample sites) were located on the channel bottom on the survey transect. This procedure was repeated at all seven proposed sample stations in the HSC.

A background station was established at the ODMDS Reference Site using the same procedures. The distance between the secondary sample sites at the background station was the same as the average distance between secondary sample sites in the HSC.



N

0 1.25 2.5 5 Miles

Legend

- Primary Sample Stations
- Location Along the HSC where the TEQ Value is equal to 120% of the ODMDS Reference Site TEQ Value
- Section of HSC where the TEQ Value is >120% of ODMDS Reference Site TEQ Value
- Section of HSC where the TEQ Value is <120% of ODMDS Reference Site TEQ Value

Notes

ESRI World Imagery

Chambers, Galveston, and Harris County, Texas

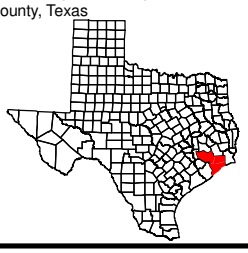


Figure 1

Characterization of Dioxins and Furans in the Houston Ship Channel

Dioxin/Furan TEQ Results

BESI Benchmark Ecological Services, Inc.

Project:TEQ_Results.mxd

Date: December 1, 2009

EP096000119

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2.2 SAMPLE COLLECTION

2.2.1 Equipment Decontamination

Sampling equipment and supplies such as the piston corer head, Ponar grab sampler, stainless steel spoons, and stainless steel bowls were decontaminated and wrapped with aluminum foil before being transported to the field. New polycarbonate core tubes were decontaminated and wrapped in plastic. A new pre-cleaned core tube was used for each sample. Decontaminated equipment was placed in plastic bags and stored in equipment boxes. Sampling equipment that required decontamination in the field was scrubbed with Alconox and distilled water and rinsed with site water.

2.2.2 Sample Station Identification

Primary sample stations and secondary sample sites were located using an on-board GPS. The boat was positioned over each station and a marker buoy was dropped. Marker buoys are designed to stay directly over the marked site and not drift with wind or current. An experienced boat operator held the boat on station while samples and field data were collected. The GPS operator recorded coordinates and water depth for each sample station while the sample was being collected.

2.2.3 Field Data Measurements

Physical and chemical parameters for water were measured at the primary sample station on each transect. The primary station was the center station on each transect (see Section 2.1). A YSI field grade meter equipped with a 50 foot cable and probe was be used to measure salinity, conductivity, turbidity, dissolved oxygen, pH, and temperature. Measurements were collected 1-foot from the bottom, at mid-depth, and 1-foot from the surface (TCEQ, 2007). The field meter was cleaned and calibrated before sampling was initiated.

2.2.4 Sampling Methods

Sediment samples were collected from the HSC using a using a piston corer and a Ponar grab sampler. A Piston corer was used to collect sediment samples at stations HSC001 through HSC006, and a Ponar grab sampler was used to collect sediment samples at channel stations HSC007 and ODS001.

Core Samples

The piston corer consists of a 3-inch diameter polycarbonate core tube attached to the end of an extendable aluminum pole. The piston corer was manually driven into the sediment until firm resistance was detected. When the core tube was withdrawn from the sediment, unconsolidated sediment was held in the core tube by negative pressure created by the piston and in some cases by a plug of consolidated material at the bottom of the tube.

A core sample was collected at each of the three sample sites (primary sample station and two secondary sample sites) on each transect. A new pre-cleaned core tube was used at each sample station. After sample collection, each core tube was plugged with a neoprene stopper, sealed,

labeled, and stored in a vertical position until the three samples for each transect were collected. GPS coordinates were recorded at each sample site.

Ponar Grab Samples
A Ponar grab sampler was used to collect sediment samples at channel station HSC007 and the ODMDS Reference Site. At channel station HSC007, the bottom was composed of coarse sand and shell hash, and no unconsolidated sediment was found. A core sample could not be collected. A grab sample was collected at each of the three sample sites on the HSC007 transect.

At the ODMDS Reference Site, three grab samples were collected on a north to south transect similar in length to the transects sampled in the HSC. GPS coordinates were recorded at each sample site.

2.2.5 Sample Processing

Core Samples
The depth (length) of each core sample was measured, and a general description of the sediment in the tube was recorded. If present, the plug of consolidated material that was occasionally found at the bottom of a core sample was removed from the core tube before the unconsolidated sediment was discharged into a bowl for homogenization. The three sediment cores collected from each transect were discharged into a single large pre-cleaned stainless steel bowl and homogenized with a pre-cleaned stainless steel spoon. This produced a single composite sample for the station. The coordinates used to represent the composite sample were the coordinates collected at the primary (middle) sample site on each transect.

Ponar Grab Samples
At the ODMDS Reference Site, the top three inches of sediment (0-3 inches depth) were removed from the center of the sampler. Sediment in contact with the sides of the sampler was not used. Sediment from the three grab samples collected from the transect was combined in a pre-cleaned stainless steel bowl for homogenization.

At HSC007 three grabs were collected. The full contents of all three samples were included in the composite sample. These procedures produced a single composite sample for each station. The coordinates used to represent the composite sample were the coordinates collected at the primary (middle) sample site on each transect.

Aliquots of sediment were removed from each bowl and placed in pre-labeled sample jars using stainless steel spoons (EPA, 1990). A pre-cleaned wide mouth 8 ounce amber jar was filled and marked for EPA Method 1613, and a pre-cleaned 8 ounce jar was filled for Total Organic Carbon (TOC) analysis. All sample containers were labeled with the sample ID, collection date, time, and chemical analysis. Sample containers were placed in re-sealable plastic bags to prevent contamination of other samples and immediately placed in an insulated box with ice for storage and transport. The Primary Sample Inventory list was updated as samples were placed in the sample boxes.

A field duplicate sample was collected at station HSC003 and labeled as HSC3-093009-002. One equipment blank was collected from the equipment used to collect and process sediment on 30

September 2009, and one equipment blank was collected from the equipment used to collect and process sediment on 07 October 2009. The two equipment blanks were labeled EB1-093009-001 and EB1-100709-002.

2.2.6 Sample Documentation

A Primary Sample Inventory list was used in the field to document the collection of all samples. The list was used to account for all samples in the field. All samples were also recorded on a chain of custody (COC) form immediately after samples were placed in a sample storage box. Sample station information, water depth, and all other pertinent observations made during the study were recorded on field data sheets.

2.2.7 Sample Storage and Transport

Bagged and labeled samples were stored in an insulated box with ice until they were delivered to the laboratory. Samples were held at 0 - 4ºC during transport and storage. A COC seal was placed on each insulated box. Samples were delivered to the analytical laboratory the day after collection. The hold time for samples analyzed for EPA Method 1613 is 1 year and the hold time for TOC analysis is 28 days. At the laboratory, a final sample check was conducted to ensure that all samples on the COC arrived at the laboratory in good condition. Custody of the samples was signed over to the laboratory.

2.2.8 Management of Investigation-Derived Wastes

Waste materials generated on board the sampling vessels (e.g., paper, plastic, aluminum foil, and latex gloves) were contained in black plastic trash bags. Bagged wastes were returned to shore for proper disposal. Collected sediment that was not used for samples was returned to the HSC where it was collected.

2.3 SAMPLE ANALYSIS

2.3.1 Laboratory Qualifications

ALS Laboratory Group (ALS) conducted the chemical analyses of the sediment for this study, and Lora Terrill was the ALS Project Manager. TOC was measured in the ALS Laboratory in Houston, Texas, USA; and Dioxin/Furan analyses were conducted at the ALS Burlington laboratory located in Ontario, Canada. The ALS Burlington laboratory is a TCEQ and National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory for EPA Method 1613.

2.3.2 Analytical Methods

Sediment samples were analyzed for TOC using the Walkley-Black method. The dioxin and furan congeners included in this study and their Chemical Abstracts Service Registry (CAS) numbers are listed in Table 1. Dioxin and furan congeners were measured using EPA Method 1613.

Table 1. Dioxin and Furan Congeners that were Analyzed

Analyte	CAS Numbers
2,3,7,8 - Tetrachloro Dibenzo-*p*-Dioxin	1746-01-6
1,2,3,7,8 - Pentachloro Dibenzo-*p*-Dioxin	40321-76-4
1,2,3,4,7,8 - Hexachloro Dibenzo-*p*-Dioxin	39227-28-6
1,2,3,6,7,8 - Hexachloro Dibenzo-*p*-Dioxin	57653-85-7
1,2,3,7,8,9 - Hexachloro Dibenzo-*p*-Dioxin	19408-74-3
1,2,3,4,6,7,8 - Heptachloro Dibenzo-*p*-Dioxin	35822-46-9
Octachloro Dibenzo-*p*-Dioxin	3266-87-9
2,3,7,8 - Tetrachloro Dibenzo-*p*-Furan	51207-31-9
1,2,3,7,8 - Pentachloro Dibenzo-*p*-Furan	57117-41-6
2,3,4,7,8 - Pentachloro Dibenzo-*p*-Furan	57117-31-4
1,2,3,4,7,8 - Hexachloro Dibenzo-*p*-Furan	55684-94-1
1,2,3,6,7,8 - Hexachloro Dibenzo-*p*-Furan	57117-44-9
2,3,4,6,7,8 - Hexachloro Dibenzo-*p*-Furan	60851-34-5
1,2,3,7,8,9 - Hexachloro Dibenzo-*p*-Furan	72918-38-8
1,2,3,4,6,7,8 - Heptachloro Dibenzo-*p*-Furan	35822-46-9
1,2,3,4,6,7,8 - Heptachloro Dibenzo-*p*-Furan	38998-75-3
Octachloro Dibenzo-*p*-Furan	39001-02-0

2.3.3 Laboratory QA/QC

Laboratory Duplicates

Duplicate analysis was performed as a measurement of precision of the analytical process. An indication of precision, Relative Percent Difference (RPD), was calculated from the two sample results. One duplicate procedure was performed.

Laboratory Matrix spikes, and Matrix Spike Duplicates

Matrix spike (MS) samples were prepared by adding a known amount of each target analyte (or a subset thereof) to a known amount of sample. The matrix spike was added at the beginning of the procedure and was carried through the entire measurement process. The parent sample (without a matrix spike) was also carried through the analytical process.

Spike recovery measures the effects of interferences caused by sample matrix in the analytical process. One matrix spike procedure was performed for this study.

A second aliquot of sediment was spiked to produce a matrix spike duplicate (MSD). This procedure evaluated the precision associated with the procedure and the analyst performing the procedure. Precision was calculated from the two sample results and is expressed as RPD.
The sample to be used for the MS/MSD was designated on the COC. The MS/MSD is used to document the bias of a method due to the sample matrix, not to control the analytical process. Laboratory corrective action, if needed, was implemented based on MS/MSD results.

Estimated Detection Limit Study
The laboratory routinely checked the instrument Method Detection Limit (MDL) to verify the laboratory's ability to reliably detect the parameter at the MDL that was used for reporting detected results and calculation of non-detected results maintained on file with the MDL data.

Method Blank
The method blank is analyte-free water or solid material that is processed simultaneously under the same conditions as the samples. A method blank was analyzed to demonstrate that the analytical system itself was not contaminated with the analyte(s) being measured.

2.3.4 Reporting of Analytical Results

ALS Laboratory provided the Benchmark Project Quality Assurance (QA) Manager with a complete Level 4 data packet on 3 December 2009. The laboratory data reports contained the results of all laboratory Quality Control (QC) measures including, but not limited to equipment blank, filter and reagent blanks, laboratory duplicates, laboratory control standards, calibration, and matrix spikes. This information was reviewed by the QA Manager and compared to the pre-specified acceptance criteria to determine acceptability of the data.

2.3.5 Data Validation

Validation of the dioxin and furan data was conducted in accordance with the US EPA document entitled "National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review" (EPA, 2005). Data validation was conducted by Nancy Toole with Environmental Chemistry Services (ECS).

2.4 DATA EVALUATION

2.4.1 Data Analysis

Analytical software used by the laboratory calculated TEQ values for each of the congeners measured in each sample. The TEQ values were summed by the reporting software to produce a total TEQ for each sample. The TEF-TEQ process was verified during laboratory data validation. During the TEQ calculation, results for congeners that were not detected (non-detects) were included in the TEQ calculation for the sample as half of the detection limit of the congener. The 1989 International (EPA) TEF values (I-TEF 1989) were used for calculation of the TEQ values for this study.

2.4.2 Regression Analysis

A regression analysis was used to calculate the distance in the HSC, south of Morgan's Point, that TEQ values would be expected to exceed the ODMDS Reference Site TEQ (5.38 pg/g) by 20% (6.46 pg/g). For convenience, distance was measured from a line extending across the HSC from Barbours Cut Terminal. Barbours Cut Terminal was selected as the reference point for distance measurements because it is a stable, easily recognized landmark. The line at Barbours Cut was considered to be mile 0, station HSC001 was 0.461 miles south of the Barbours Cut reference point, and station HSC007 was 25.532 miles south of Barbours Cut. A second degree polynomial model (Figure 2) provided the best fit to the TEQ values and distance (miles) from the Barbours Cut Terminal.

3.0 RESULTS

3.1 WATER CHEMISTRY

Physical and chemical parameters were collected at the primary site on each transect and at the ODMDS Reference Site. At the HSC stations bay water was well mixed. Salinity and turbidity were slightly higher at the bottom at most stations when compared to mid-depth and surface readings. No parameters were found to be outside the normal range. Water quality data are listed in Appendix B, Table 1.

3.2 FIELD OBSERVATIONS

Field data associated with each of the Primary and Secondary sample stations was recorded on data sheets during the sampling events. Recorded data includes sample date, sample time, water depth, depth of sample, and sediment description. A summary of field data is provided in Appendix B, Table 2.

3.3 SEDIMENT TEQ VALUES

All of the sediment samples collected from the HSC had detectable levels of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzo-furans. The analytical results for all channel stations and the ODMDS Reference Site are shown in Table 2. The highest concentrations of dioxins and furans were found at station HSC001 near Morgan's Point. TEQ values decreased almost linearly through station HSC007.

GPS coordinates for the Barbours Cut reference point, HSC sample stations, TEQ target, and ODMDS Reference Site are shown in Table 3. Coordinates recorded for the primary (middle) site, in the channel and at the ODMDS Reference Site, were used to represent the composite samples. Coordinates for the HSC stations and ODMDS Reference Site were recorded in the field. Coordinates for the Barbours Cut reference point and TEQ target point (6.46 pg/g) were produced in ArcMap®.

The best fit regression model for TEQ values over distance was the second degree polynomial model shown in Figure 2. The R^2 value for the regression was 0.9476. The regression was used to calculate the distance from Barbours Cut to the point in the channel where sediment TEQ values would be expected to be equal to 120% of the ODMDS Reference Site TEQ value.

The ODMDS Reference Site TEQ was 5.38 pg/g, and 120% of the ODMDS Reference Site TEQ was 6.46 pg/g (TEQ target). The target TEQ of 6.46 pg/g was used in the regression model. The regression model indicated that TEQ values of 6.46 pg/g would be found in sediment at a point 7.164 miles south of the Barbours Cut Terminal (Figures 1 and 2).

Table 2. Analytical Results for Sediment from Channel Stations HSC001 to HSC007 and the Reference Station ODS001

Station	Sample ID	Sample Date	Sample Time	TEQ (pg/g)[1]	TOC (wt%)	% Moisture
HSC001	HSC1-093009-001	9/30/2009	9:02	9.05	1.05	57.7
HSC002	HSC2-093009-001	9/30/2009	11:23	7.52	1.17	55.1
HSC003	HSC3-093009-001	9/30/2009	13:15	6.07	0.943	50.2
	HSC3-093009-002[2]	9/30/2009	13:20	4.20	0.817	44.8
HSC004	HSC4-100709-001	10/7/2009	12:40	3.76	0.650	42.8
	HSC4-100709-001[3]	10/7/2009	12:40	3.72	0.631	43.7
HSC005	HSC5-100709-001	10/7/2009	11:40	2.75	1.13	32.9
HSC006	HSC6-100709-001	10/7/2009	9:45	3.29	1.19	38.3
HSC007	HSC7-100709-001	10/7/2009	15:10	0.214	0.503	11.3
ODS001	ODS1-100709-001	10/7/2009	9:02	5.38	1.58	59.0

[1]Dioxin/Furan Total TEQ - toxicity equivalents relative to 2,3,7,8-tetrachlorodibenzodioxin, (Based on ND=0.5DL) ND - Non Detect, DL - Detection Limit, Total TEQ calculated using International toxicity equivalency factor scheme (EPA, 1989)

[2]Field duplicate

[3]Laboratory duplicate

Table 3. GPS Coordinates, TEQ Values, and Distance from the Barbours Cut Terminal

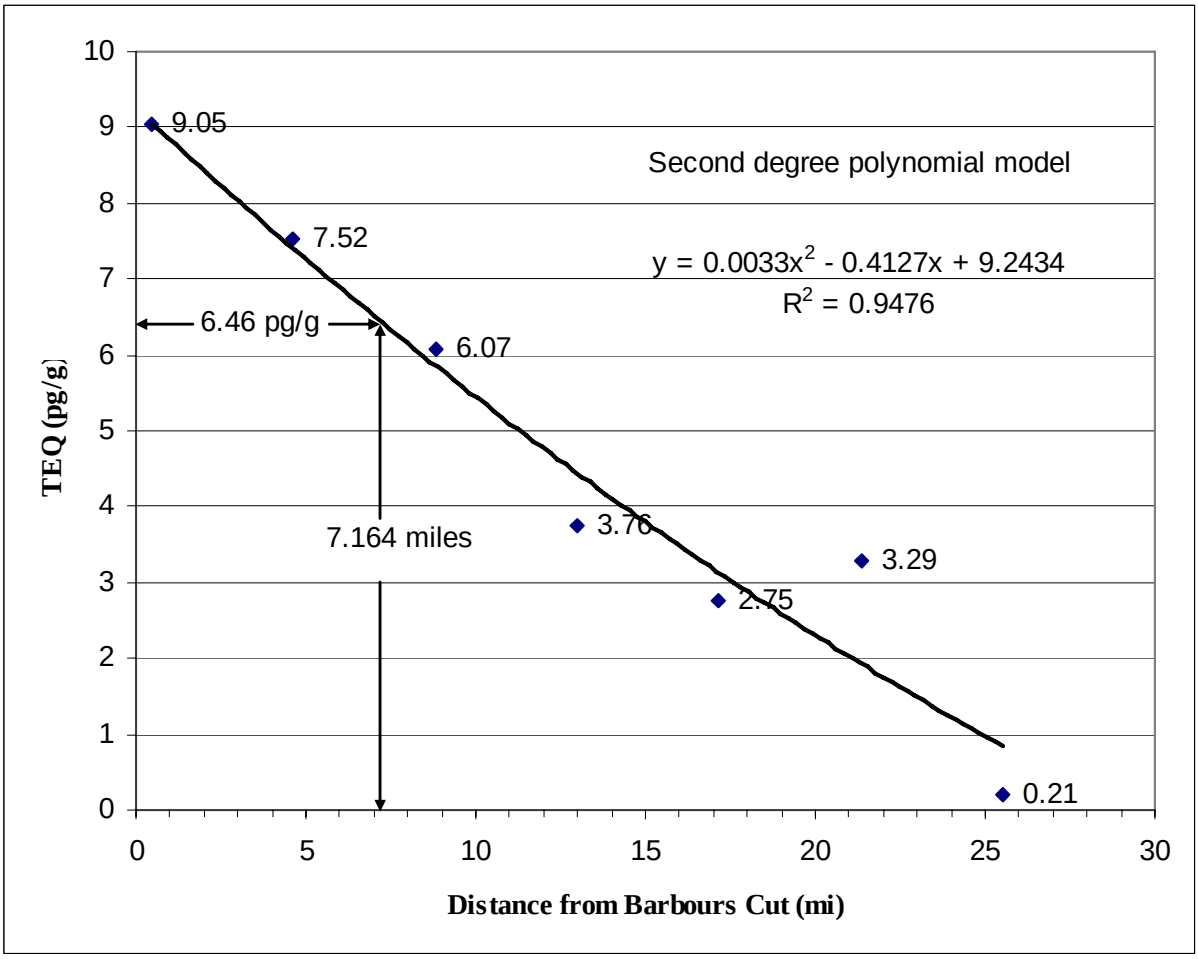
Station/Location	Distance (miles)[1]	TEQ (pg/g)[2]	Coordinates[3]	
			Easting	Northing
Barbours Cut	0	NA	3244195.83	13817604.45
HSC001	0.46	9.05	3244982.64	13815322.55
HSC002	4.64	7.52	3252567.73	13794602.16
TEQ = 120% of Reference Site	7.164	6.46	3259508.14	13783298.50
HSC003	8.82	6.07	3264636.99	13776250.09
HSC004	13.00	3.76	3277612.11	13758361.44
HSC005	17.18	2.75	3288655.41	13739400.10
HSC006	21.36	3.29	3298353.98	13719596.49
HSC007	25.54	0.214	3309472.22	13700770.71
ODS001	NA	5.38	3364049.73	13693971.57

[1]Distance from the Southern tip of the Barbours Cut Channel

[2]Dioxin/Furan Total TEQ - toxicity equivalents relative to 2,3,7,8-tetrachlorodibenzodioxin, (Based on ND=0.5DL) ND - Non Detect, DL - Detection Limit, Total TEQ calculated using International toxicity equivalency factor scheme (EPA, 1989)

[3] Coordinates associated with the Primary Sample Stations and are listed in NAD 83 Texas South Central Survey Feet

Figure 2. Second Degree Polynomial Regression used to predict TEQ values in Houston Ship Channel sediment based on distance from Reference Point at Barbours Cut



The regression in Figure 2 shows the predicted TEQ values for channel sediment and the distance from the reference point at Barbours Cut. The point where the regression model equals 6.46 pg/g (TEQ target) is 7.164 miles from the reference point at Barbours Cut. Sediment in the channel more than 7.164 miles south of Barbours Cut would be expected to have TEQ values less than 6.46 pg/g.

3.4 FIELD QA/QC ASSESSMENT

3.4.1 Field Duplicate

A field duplicate sample was collected at station HSC003 and labeled as HSC3-093009-002.

3.4.2 Equipment Blanks

One equipment blank was collected from the equipment used to collect and process sediment on 30 September 2009, and one equipment blank was collected from the equipment used to collect and process sediment on 07 October 2009. Two equipment blanks were collected and labeled EB1-093009-001 and EB1-100709-002.

3.5 LABORATORY AND DATA MANAGEMENT QA/QC ASSESSMENT

3.5.1 Overall Assessment of Data

The data covered by this report are acceptable for use in meeting project objectives as qualified based on the following data quality assurance objectives:

Accuracy – as measured through analysis of Laboratory Fortified Blank (LFB) samples and Laboratory Fortified Matrix/Duplicate (LFM/D) samples. Since 99% of these were within the applicable acceptance ranges, the overall level of accuracy is considered acceptable.

Precision- as measured by the analysis of laboratory and field duplicates was within applicable acceptance ranges. Since 100% of these samples were within the applicable acceptance ranges, overall precision is considered acceptable.

Completeness- measured as the ratio of the number of valid analytical results to the total number of analytical results requested meets the goal of 90% for soild matrix samples. Overall completeness is considered acceptable.

Representativeness- as measured by comparing the results obtained for the field duplicate pairs, use of sampling procedures contained in the Quality Assurance Project Plan (QAPP) and relevant Standard Operating Procedures (SOPs) is considered acceptable.

3.5.2 QA/QC Conclusions

The chemical data generated during this study and covered by the Data Validation Report (Appendix C) are considered usable for meeting the project objective of determining the Polychlorinated Dibenzo-p-Dioxin and Polychlorinated Dibenzo-Furan concentrations in sediment samples with the qualifications presented in the Data Usability Report. Copies of the Laboratory Data Packets are on compact disc in Appendix D.

3.6 CORRECTIVE ACTION

3.6.1 Field Corrective Action

The field sampling team was forced to modify the Sampling Plan and use a Ponar grab sampler at ship channel station HSC007. The plan specified the use of a piston core sampler at ship channel stations. The bottom of the channel at station HSC007 was composed of coarse sand and shell hash; therefore, a piston corer could not be used. A Ponar grab sampler was used to collect the sample. The sample collected by the grab sampler met the sampling objectives of the study and was considered a valid, representative sample.

3.6.2 Laboratory Corrective Action

During sample check-in at the analytical laboratory the sample identification number for the sample collected from the ODMDS Reference Site was misinterpreted. The correct sample number, which was ODS001, was mistakenly transcribed as 005001. The ODMDS Reference Site sample is identified in the laboratory report as 005001. The mistake was detected during QA/QC assessments and documented. Since the altered sample ID was unique and the sample was identified as the ODMDS Reference Site sample, no misinterpretation of the data was possible.

3.6.3 Corrective Action During Data Validation and Data Assessment

During initial data assessment, it was determined that the laboratory report did not contain TEQ values generated using ½ the detection limit (DL) of the congener, when the congener was not detected (ND). The report provided TEQ values for congeners where ND = 0 and where ND = DL were used. The laboratory report was re-generated, and TEQ values for congeners where ND = ½ DL were provided. This corrective action did not compromise the validity of the sample data.

4.0 REFERENCES

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Appendix A

Bathymetric Survey Report

1.0 Introduction

A Survey Plan was developed by Benchmark Ecological Services, Inc. to provide guidance for the bathymetric evaluation that was conducted at each sample station on the Houston Ship Channel (HSC). The survey plan was included as Appendix A in the Sampling and Analysis Plan/Quality Assurance Project Plan for the Characterization of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzo-Furans Contaminants in Sediment of the Houston Ship Channel Between Morgan's Point and Galveston Island in Galveston Bay, Texas. The results of field survey are summarized in this report.

2.0 Mobilization

A map showing all proposed sample stations and proposed sampling transects was developed before the survey was initiated. Each transect was a straight line that spanned the HSC and intersected the channel centerline at each sample station. Coordinates for the starting and end points of each transect were entered into a Global Positioning System (GPS). In addition to the end points, data collection points were created on the transect line at fifty (50) foot intervals in ArcMap® and were loaded into the GPS.

3.0 Data Collection

The Benchmark survey boat was placed on the HSC001 transect over the West end point. Water depth and GPS coordinates were recorded at the starting point on 30 September 2009. As the boat motored across the HSC along the transect, water depth and coordinates were recorded at each data collection point. Data was recorded in the GPS and on the Survey Data Sheet. This procedure was repeated at stations HSC002 and HSC003 on 30 September 2009 and HSC004, HSC005, HSC006, HSC007 on 7 October 2009. Transect waypoints, coordinates, and water depths are summarized for each HSC sample stations in tables included in Attachment A. A cross-section of the channel was generated and the transition between channel bottom and side-slope was identified based on the collected GPS data. Transect cross sections for all seven HSC sample stations are included in Attachment B. Secondary sample stations were located on the channel bottom, near the transition between channel bottom and side slope. The Primary Sample Station (PSS) was located between the East and West secondary sample stations.

The Offshore Dredged Material Disposal Site (ODMDS) Reference Site sample stations were located along a transect running North-South. The distance between the North sample station and the South sample station was approximately 500 ft. which was based on the average distance between the East and West secondary sample stations established in the HSC. ODMDS Reference Site sample station coordinates and water depths are included in Attachment A.

Attachment A

Bathymetric Survey Report

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
HSC001	4529	9.4 ft	3244522.37	13815137.94	
	4530	8.4 ft	3244568.42	13815175.69	
	4531	8.1 ft	3244616.55	13815170.18	
	4532	11.4 ft	3244659.97	13815202.12	
	4533	24.7 ft	3244708.96	13815220.55	
	4534	37.3 ft	3244759.18	13815224.53	
	4550	45.7 ft	3244799.41	13815236.57	West Sample Station
	4535	44.1 ft	3244805.52	13815233.47	
	4536	46.3 ft	3244855.36	13815256.91	
	4537	48.1 ft	3244895.43	13815284.63	
	4538	50.2 ft	3244942.16	13815306.75	
	4552	53.7 ft	3244982.64	13815322.55	Primary Sample Station
	4539	53.2 ft	3244992.39	13815311.68	
	4540	54.1 ft	3245047.10	13815306.91	
	4541	53.6 ft	3245093.48	13815332.19	
	4542	53.8 ft	3245135.41	13815359.28	
	4551	44.8 ft	3245175.87	13815380.07	East Sample Station
	4543	51.4 ft	3245180.85	13815376.78	
	4544	47.9 ft	3245223.30	13815394.32	
	4545	44.5 ft	3245276.99	13815414.58	
	4546	42.6 ft	3245321.79	13815426.75	
	4547	33.9 ft	3245360.43	13815435.82	
	4548	18.1 ft	3245414.90	13815452.18	
	4549	15.8 ft	3245471.82	13815471.86	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
HSC002	4576	10.8 ft	3251777.27	13794452.52	
	4577	13.9 ft	3251997.95	13794447.52	
	4578	30.0 ft	3252085.87	13794440.59	
	4553	44.4 ft	3252275.50	13794485.86	
	4573	45.6 ft	3252318.89	13794505.95	
	4579	45.8 ft	3252328.34	13794492.85	West Sample Station
	4554	45.1 ft	3252373.37	13794522.82	
	4555	47.7 ft	3252440.97	13794541.06	
	4556	46.6 ft	3252468.12	13794566.70	
	4557	47.8 ft	3252503.17	13794602.11	
	4581	51.6 ft	3252567.73	13794602.16	Primary Sample Station
	4572	52.1 ft	3252574.90	13794613.76	
	4558	53.9 ft	3252616.74	13794591.63	
	4559	54.7 ft	3252672.49	13794635.95	
	4571	52.9 ft	3252711.61	13794629.19	
	4580	42.8 ft	3252756.13	13794672.90	East Sample Station
	4570	52.2 ft	3252756.19	13794684.87	
	4560	52.3 ft	3252804.94	13794680.95	
	4569	42.3 ft	3252843.00	13794727.64	
	4568	38.0 ft	3252893.38	13794734.07	
	4561	30.1 ft	3252947.21	13794709.30	
	4567	30.4 ft	3252991.88	13794779.94	
	4563	20.2 ft	3253095.67	13794772.69	
	4566	15.8 ft	3253125.10	13794808.82	
	4565	12.7 ft	3253177.38	13794837.66	
	4564	12.0 ft	3253213.76	13794860.42	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
HSC003	4582	16.6 ft	3264207.65	13775962.17	
	4583	18.4 ft	3264249.62	13775987.24	
	4584	20.4 ft	3264302.88	13776009.62	
	4585	26.6 ft	3264343.92	13776045.00	
	4586	38.0 ft	3264394.61	13776064.45	
	4603	46.4 ft	3264421.23	13776108.24	West Sample Station
	4587	48.4 ft	3264445.47	13776085.25	
	4588	49.8 ft	3264484.18	13776125.53	
	4589	51.0 ft	3264516.04	13776153.17	
	4590	52.1 ft	3264556.20	13776172.54	
	4591	52.0 ft	3264603.77	13776207.78	
	4604	53.5 ft	3264636.99	13776250.09	Primary Sample Station
	4592	52.7 ft	3264645.12	13776237.79	
	4593	51.9 ft	3264680.61	13776264.53	
	4594	52.2 ft	3264715.14	13776288.55	
	4595	51.3 ft	3264764.09	13776312.30	
	4596	50.4 ft	3264809.27	13776336.47	
	4597	48.9 ft	3264852.19	13776366.32	
	4602	48.3 ft	3264893.28	13776410.17	East Sample Station
	4598	48.3 ft	3264899.52	13776390.74	
	4599	36.0 ft	3264947.71	13776413.42	
	4600	20.4 ft	3264988.04	13776445.57	
	4601	17.3 ft	3265029.54	13776467.54	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
HSC004	4687	22.4 ft	3277245.93	13758127.88	
	4688	33.8 ft	3277297.97	13758164.75	
	4689	44.7 ft	3277339.40	13758198.15	
	4709	51.2 ft	3277380.34	13758263.01	West Sample Station
	4690	51.2 ft	3277382.58	13758229.25	
	4691	52.7 ft	3277420.63	13758265.70	
	4692	54.5 ft	3277456.52	13758301.13	
	4693	50.8 ft	3277500.64	13758333.14	
	4694	52.8 ft	3277538.86	13758354.02	
	4695	55.9 ft	3277579.58	13758379.69	
	4708	55.9 ft	3277612.11	13758361.44	Primary Sample Station
	4696	49.1 ft	3277643.98	13758396.18	
	4697	51.3 ft	3277663.84	13758435.99	
	4698	56.1 ft	3277704.99	13758461.16	
	4699	53.3 ft	3277739.50	13758506.99	
	4700	50.8 ft	3277782.53	13758534.84	
	4707	47.0 ft	3277795.79	13758522.36	East Sample Station
	4701	47.6 ft	3277827.15	13758554.46	
	4702	31.0 ft	3277872.15	13758576.13	
	4703	25.5 ft	3277904.69	13758604.67	
	4704	23.4 ft	3277957.45	13758635.24	
	4705	20.7 ft	3278000.72	13758657.18	
	4706	19.9 ft	3278040.19	13758692.29	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
HSC005	4661	15.7 ft	3288188.14	13739232.78	
	4662	19.3 ft	3288246.73	13739236.32	
	4663	23.8 ft	3288301.62	13739249.72	
	4664	30.0 ft	3288345.71	13739266.10	
	4665	38.4 ft	3288399.31	13739290.23	
	4666	43.4 ft	3288443.37	13739305.66	
	4667	47.9 ft	3288487.56	13739317.23	
	4668	49.2 ft	3288531.38	13739343.16	
	4686	55.1 ft	3288538.79	13739341.71	West Sample Station
	4669	49.9 ft	3288569.92	13739366.03	
	4670	52.2 ft	3288623.56	13739380.64	
	4685	48.0 ft	3288655.41	13739400.10	Primary Sample Station
	4672	48.9 ft	3288676.25	13739409.57	
	4673	50.6 ft	3288726.45	13739432.46	
	4674	49.8 ft	3288749.63	13739463.88	
	4675	48.7 ft	3288808.48	13739454.51	
	4676	49.9 ft	3288860.62	13739479.03	
	4684	56.5 ft	3288882.06	13739485.97	East Sample Station
	4677	48.2 ft	3288911.17	13739519.79	
	4678	47.9 ft	3288937.50	13739536.81	
	4679	47.4 ft	3288980.69	13739560.86	
	4680	45.6 ft	3289020.32	13739585.30	
	4681	33.8 ft	3289065.94	13739615.84	
	4682	24.0 ft	3289109.21	13739646.31	
	4683	19.5 ft	3289167.80	13739673.31	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
HSC006	4634	15.2 ft	3297738.38	13719306.92	
	4635	17.4 ft	3297781.65	13719325.42	
	4636	21.4 ft	3297834.66	13719337.94	
	4637	27.4 ft	3297875.70	13719370.92	
	4638	29.6 ft	3297929.14	13719402.62	
	4639	35.0 ft	3297964.74	13719417.21	
	4640	43.5 ft	3298013.49	13719440.35	
	4641	49.0 ft	3298058.73	13719464.30	
	4642	52.7 ft	3298096.41	13719483.26	
	4659	54.2 ft	3298131.14	13719499.13	West Sample Station
	4643	53.4 ft	3298139.61	13719495.72	
	4644	55.2 ft	3298197.26	13719512.00	
	4645	54.4 ft	3298253.24	13719525.32	
	4646	55.2 ft	3298296.70	13719543.86	
	4647	55.0 ft	3298342.10	13719564.33	
	4660	55.1 ft	3298353.98	13719596.49	Primary Sample Station
	4648	55.4 ft	3298388.93	13719580.42	
	4649	56.2 ft	3298432.42	13719601.54	
	4650	58.1 ft	3298477.77	13719628.82	
	4651	56.2 ft	3298507.53	13719659.82	
	4658	57.6 ft	3298537.09	13719674.38	East Sample Station
	4652	54.2 ft	3298559.35	13719680.81	
	4653	47.1 ft	3298604.54	13719701.82	
	4654	34.0 ft	3298654.50	13719722.09	
	4655	28.8 ft	3298731.89	13719742.36	
	4656	27.7 ft	3298800.83	13719767.13	
	4657	24.1 ft	3298871.39	13719789.51	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
	4610	38.2 ft	3309007.14	13700462.63	
	4611	40.7 ft	3309084.63	13700487.22	
	4612	44.4 ft	3309125.61	13700536.39	
	4613	45.7 ft	3309145.10	13700563.29	
	4614	47.9 ft	3309176.53	13700601.28	
	4615	50.3 ft	3309204.04	13700624.39	
	4616	53.0 ft	3309260.77	13700661.76	
	4617	54.6 ft	3309299.94	13700691.04	
	0018	50.9 ft	3309316.02	13700654.15	West Sample Station
	4618	54.9 ft	3309344.04	13700719.85	
	4619	54.3 ft	3309380.44	13700749.03	
	4620	53.7 ft	3309416.87	13700782.68	
	4621	53.6 ft	3309459.07	13700816.40	
HSC007	0019	50.1 ft	3309472.22	13700770.71	Primary Sample Station
	4622	51.5 ft	3309496.16	13700840.59	
	4623	52.0 ft	3309542.78	13700866.61	
	4624	53.9 ft	3309587.36	13700894.34	
	4625	54.2 ft	3309621.48	13700929.26	
	4626	53.0 ft	3309659.76	13700969.93	
	0020	49.1 ft	3309690.15	13700936.17	East Sample Station
	4627	52.8 ft	3309695.17	13700996.75	
	4628	50.7 ft	3309737.17	13701025.15	
	4629	47.9 ft	3309785.53	13701051.60	
	4630	43.6 ft	3309840.31	13701072.27	
	4631	39.2 ft	3309896.36	13701098.41	
	4632	33.0 ft	3309966.95	13701159.65	
	4633	32.9 ft	3310042.31	13701208.24	

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment A Table 1 - Bathymetry Survey Waypoints, Water Depths, and Coordinates

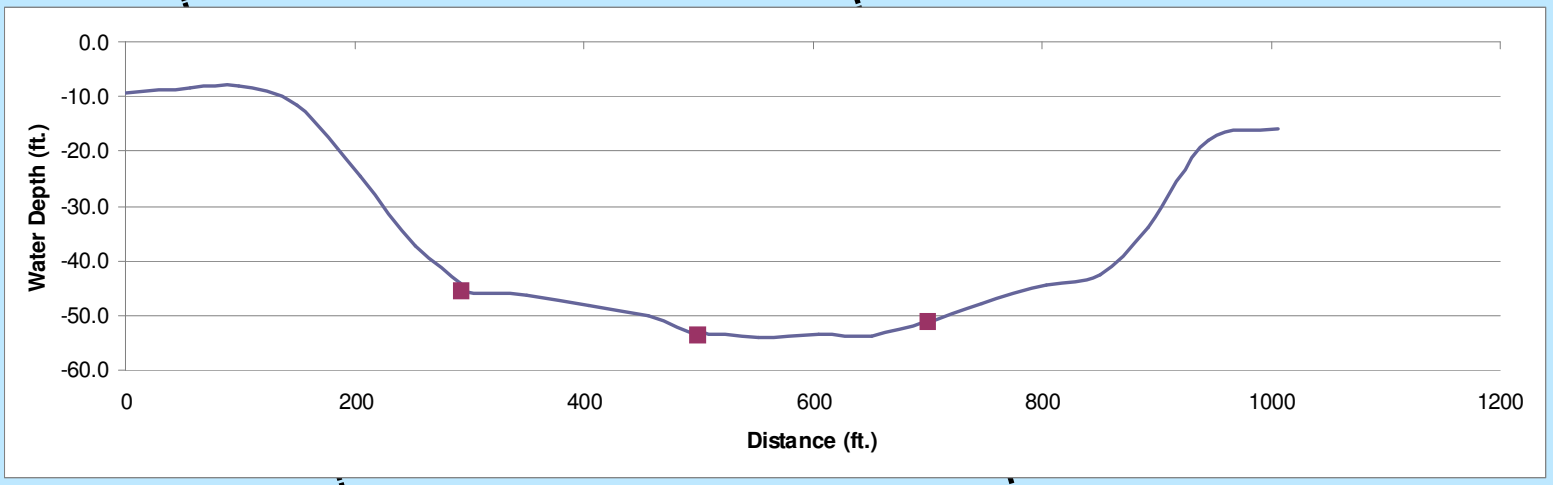
Station	Waypoint	Water Depth[1]	Coordinates[2]		Comments
			Easting	Northing	
ODMDS	0015	36.9 ft	3363950.77	13694183.85	North Sample Station
ODMDS	0016	36.5 ft	3364049.73	13693971.57	Primary Sample Station
ODMDS	0017	37.5 ft	3364117.27	13693743.27	South Sample Station

[1] Water Depth not tied to MLT, actual water depth at time of survey

[2] Coordinates listed in NAD 83 Texas South Central Survey Feet

Attachment B

Bathymetric Survey Report



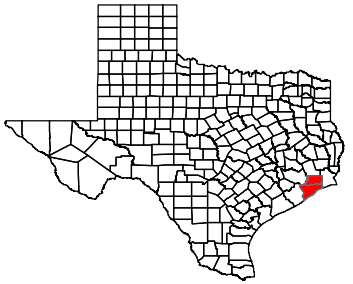
N

0 50 100 200 Feet

HSC001 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC001 Bathymerty Transect

U.S. Environmental Protection Agency

Houston Ship Channel
Dioxin & Furan Sediment Study

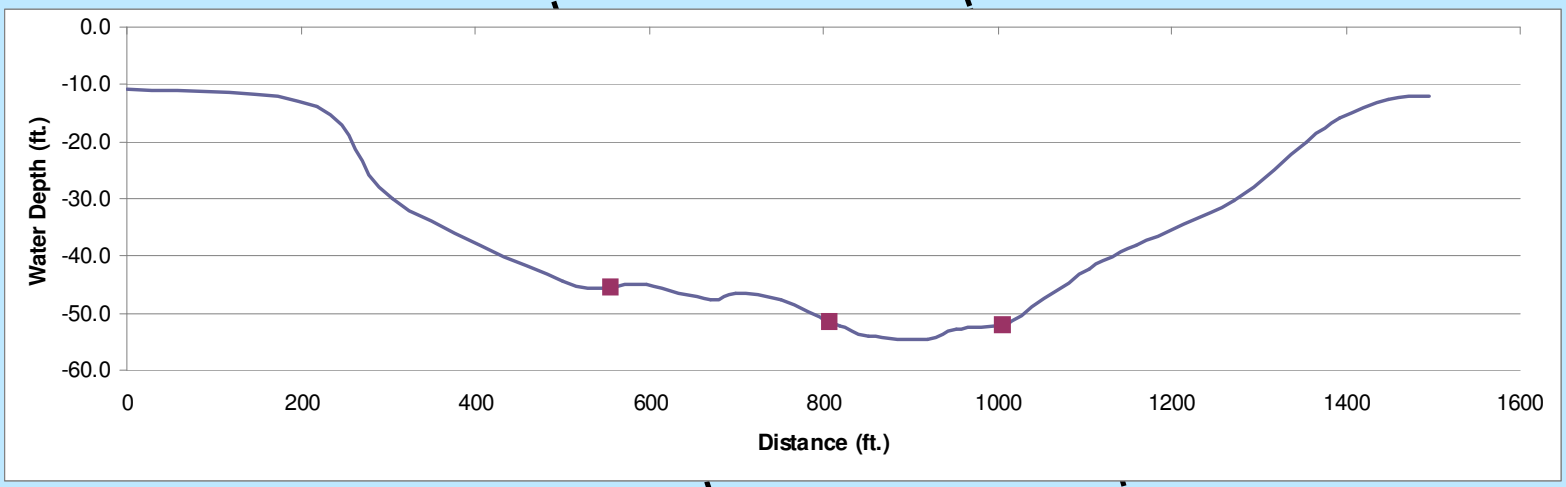
BESI Benchmark Ecological Services, Inc.

Project: 09004-001

Date: 12/02/2009

Figure 1a

M:\09004\001\arc\field\station1.mxd



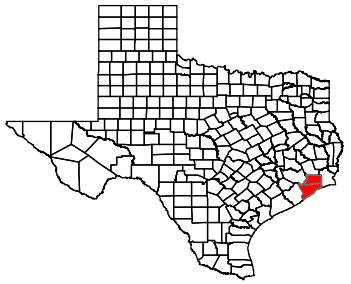
N

0 75 150 300 Feet

HSC002 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC002 Bathymetry Transect

U.S. Environmental Protection Agency

Houston Ship Channel
Dioxin & Furan Sediment Study

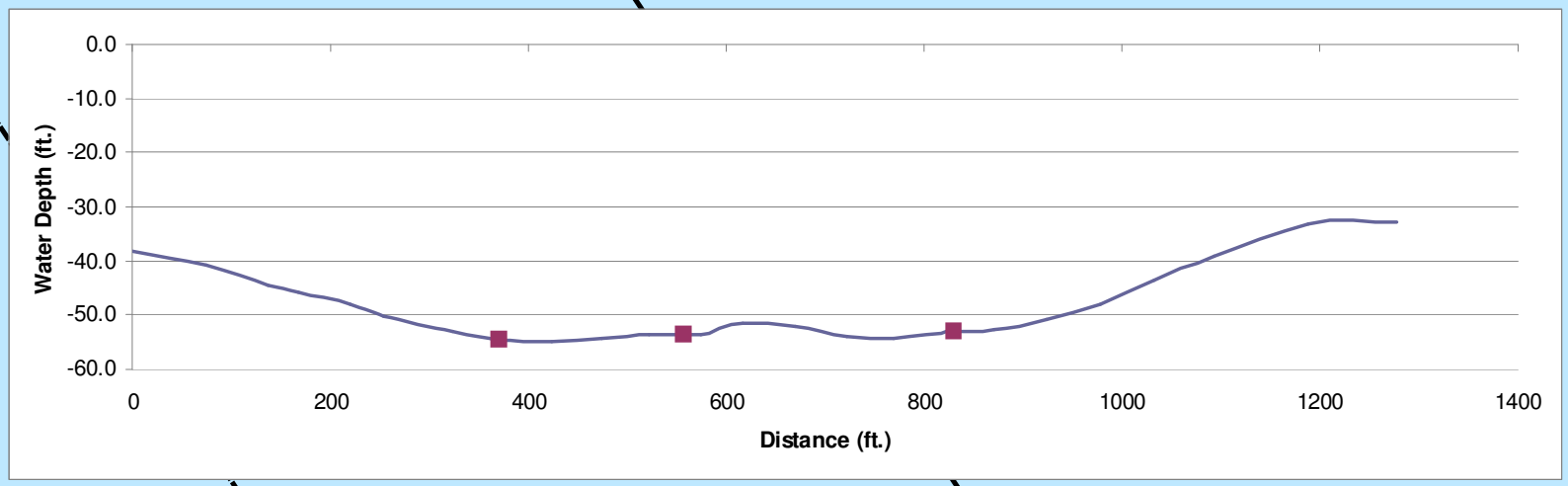
BESI Benchmark Ecological Services, Inc.

Project:09004-001

Date: 12/02/2009

Figure 1b

M:\09004\001\arc\field\station2.mxd



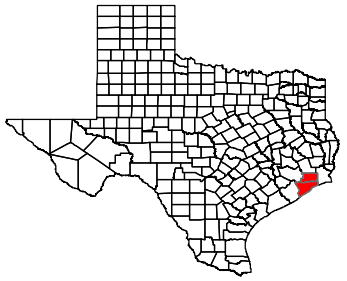
N

0 50 100 200 Feet

HSC003 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC003 Bathymetry Transect

U.S. Environmental Protection Agency

Houston Ship Channel
Dioxin & Furan Sediment Study

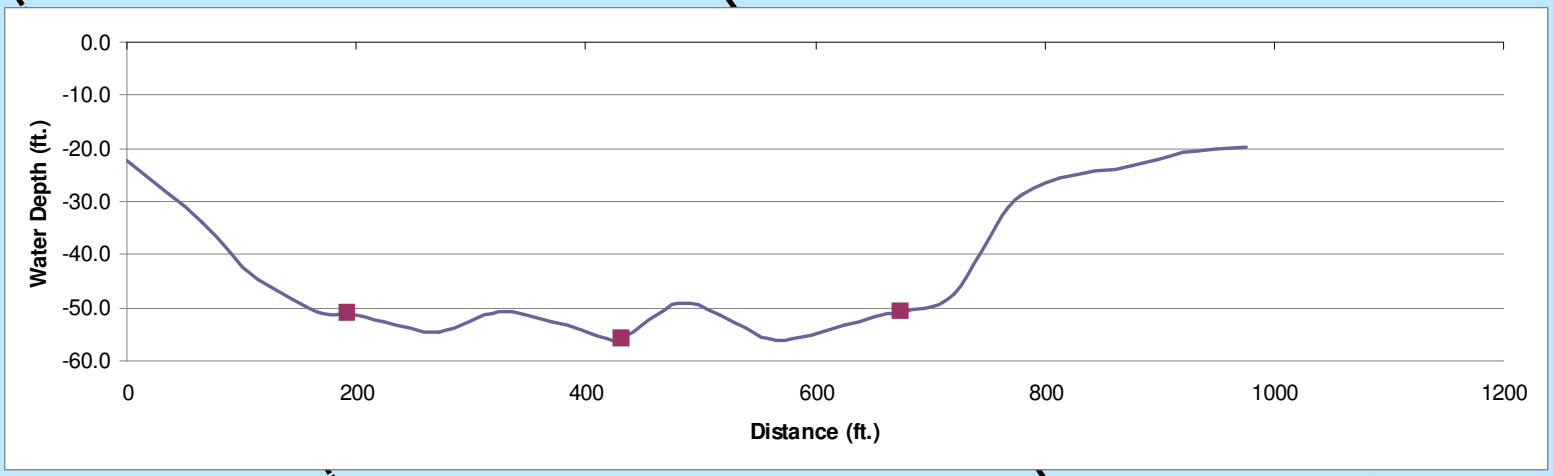
BESI Benchmark Ecological Services, Inc.

Project:09004-001

Date: 12/02/2009

Figure 1c

M:\09004\001\arc\field\station3.mxd



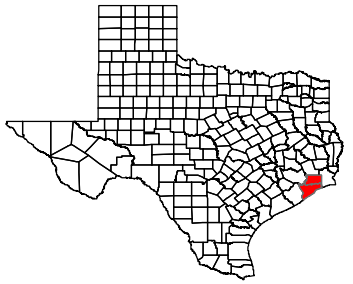
N

0 50 100 200 Feet

HSC004 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC004 Bathymetry Transect

U.S. Environmental Protection Agency

Houston Ship Channel
Dioxin & Furan Sediment Study

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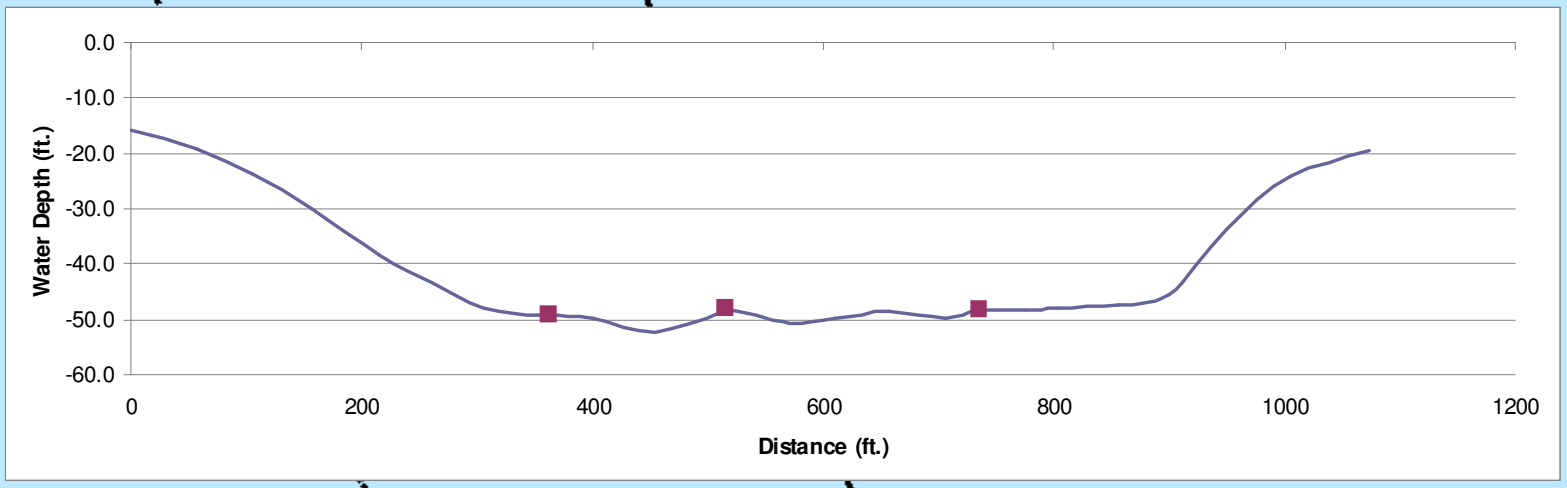
Project:09004-001

Date: 12/02/2009

Figure 1d

M:\09004\001\arc\field\station4.mxd



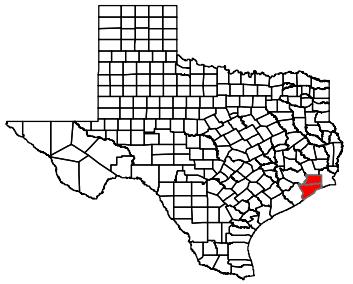
N

0 50 100 200 Feet

HSC005 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC005 Bathymetry Transect

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Dioxin & Furan Sediment Study

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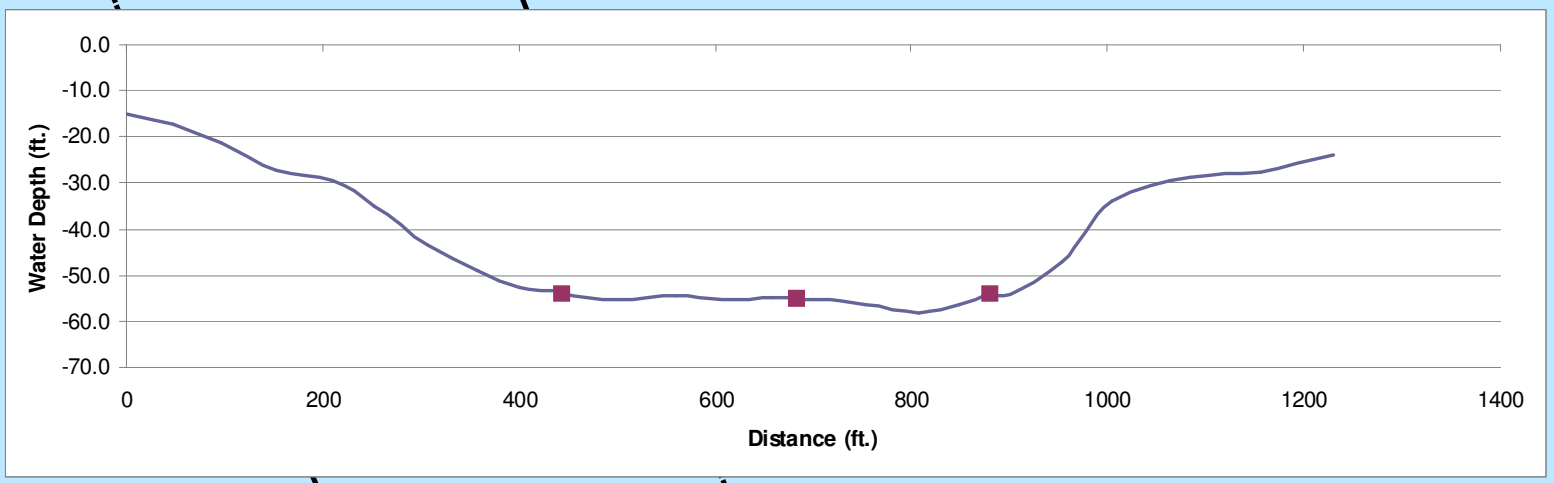
Date: 10/12/09

Figure 1e

M:\09004\001\arc\field\station5.mxd



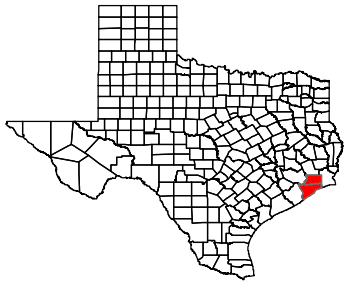
N

0 50 100 200 Feet

HSC006 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC006 Bathymetry Transect

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Dioxin & Furan Sediment Study

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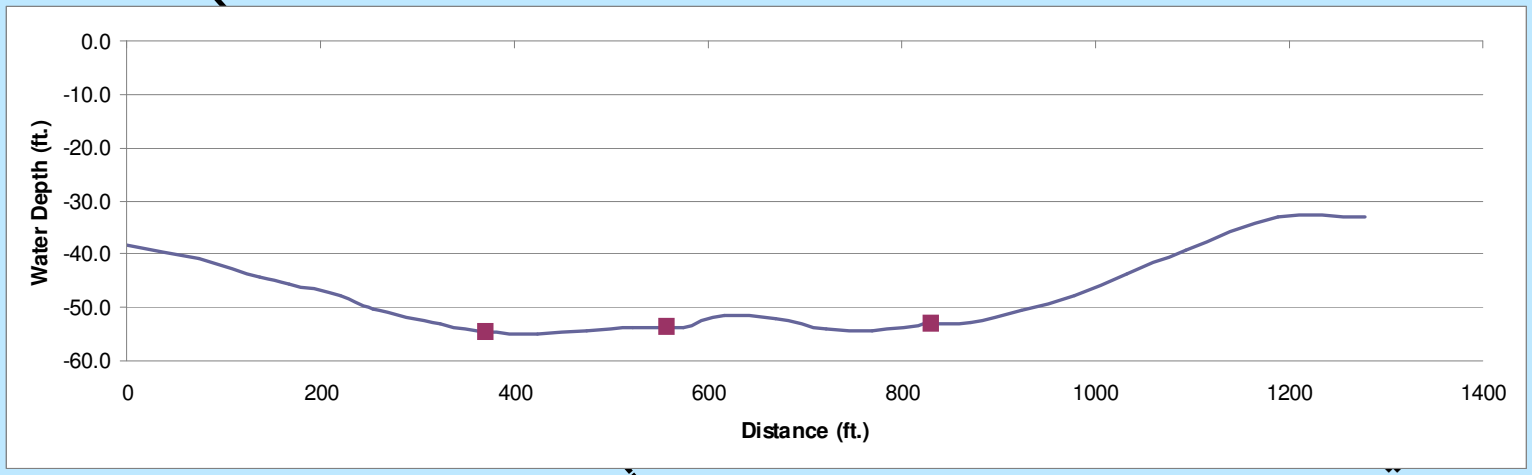
Project:09004-001

Date: 12/02/2009

Figure 1f

M:\09004\001\arc\field\station6.mxd



Houston Ship Channel

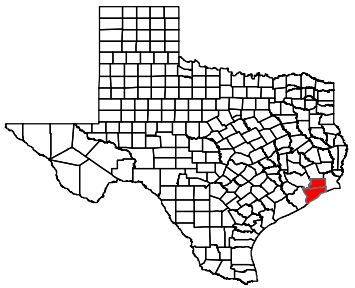
N

0 50 100 200 Feet

HSC007 Transect

- Bathymetry Point
- Sample Location
- Houston Ship Channel
- Water

Notes



HSC007 Bathymetry Transect

U.S. Environmental Protection Agency

Houston Ship Channel
Dioxin & Furan Sediment Study

BESI Benchmark Ecological Services, Inc.

Project:09004-001

Date: 12/02/2009

Figure 1g

M:\09004\001\arc\field\station7.mxd

Appendix B

Appendix B Table 1 - Water Parameters

Station	Parameters	Surface	Mid Depth	Bottom
HSC001	pH	7.27	7.65	7.63
	DO (mg/L)	5.99	5.69	5.63
	Temperature (˚C)	26.07	26.07	26.15
	Conductivity (mS)	37.58	38.30	39.01
	Turbidity (NTU)	10.4	13.3	31.9
	Salinity (ppt)	23.17	23.88	24.48
HSC002	pH	7.90	7.92	7.93
	DO (mg/L)	6.40	5.95	5.94
	Temperature (˚C)	25.81	25.82	25.89
	Conductivity (mS)	39.20	39.63	40.46
	Turbidity (NTU)	8.7	8.1	25.0
	Salinity (ppt)	24.52	24.76	25.34
HSC003	pH	7.75	7.78	7.76
	DO (mg/L)	7.43	6.51	6.12
	Temperature (˚C)	26.52	26.25	25.9
	Conductivity (mS)	42.44	41.17	41.45
	Turbidity (NTU)	6.0	7.9	9.1
	Salinity (ppt)	26.41	23.62	26.52
HSC004	pH	7.80	7.78	7.80
	DO (mg/L)	7.31	6.54	6.84
	Temperature (˚C)	27.71	26.96	26.75
	Conductivity (mS)	36.23	36.01	40.17
	Turbidity (NTU)	3.0	6.9	28.7
	Salinity (ppt)	21.58	22.50	24.75
HSC005	pH	7.82	7.74	7.85
	DO (mg/L)	7.52	7.30	8.60
	Temperature (˚C)	27.82	26.91	26.68
	Conductivity (mS)	38.42	39.60	40.20
	Turbidity (NTU)	3.9	7.1	6.4
	Salinity (ppt)	22.97	24.23	25.96
HSC006	pH	7.82	7.77	7.77
	DO (mg/L)	7.43	7.01	6.92
	Temperature (˚C)	27.33	27.06	27.0
	Conductivity (mS)	10.82	40.20	42.46
	Turbidity (NTU)	7.6	5.6	8.0
	Salinity (ppt)	26.13	24.54	26.13
HSC007	pH	7.81	7.82	7.81
	DO (mg/L)	6.51	6.60	6.65
	Temperature (˚C)	26.84	26.84	26.86
	Conductivity (mS)	42.78	42.42	42.72
	Turbidity (NTU)	17.1	17.1	15.9
	Salinity (ppt)	25.97	26.20	26.37

Appendix B Table 1 - Water Parameters

Station	Parameters	Surface	Mid Depth	Bottom
ODS001	pH	8.11	8.08	7.96
	DO (mg/L)	6.73	6.21	4.76
	Temperature (˚C)	27.54	27.46	26.84
	Conductivity (mS)	45.32	45.31	44.9
	Turbidity (NTU)	0.3	0.4	10.8
	Salinity (ppt)	27.75	27.80	27.87

Appendix B Table 2 - Sample Date, Time, Water Depth , Sample Depth, and Sediment Description

Station		Sample Date	Sample Time	Water Depth (ft)[1]	Sample Depth (in)	Sample Method	Sediment Description
HSC001	West Station	9/30/2009	8:50	45.7	62	Piston Core	0-1 in Light brown sandy silt 1-62 in Dark gray silty clay
	Primary Station		9:02	53.7	17		0-2 in Light brown sandy silt 2-17 in Gray silty clay
	East Station		9:20	51.4	66		0-0.5 in Brown silty sand 0.5-66 in Light gray silty clay
HSC002	West Station	9/30/2009	10:46	45.6	68	Piston Core	0-1 in Light brown sandy silt 1-68 in Gray silty clay
	Primary Station		11:23	51.6	52		0-2 in Light brown silty sand 2-52 in Light gray silty clay
	East Station		11:03	42.8	52		0-3 in Light gray silty sand 3-48 in Light gray silty clay 48-52 in Gray clay
HSC003	West Station	9/30/2009	12:53	46.4	29	Piston Core	0-2 in Light brown silty sand 2-28 in Gray silty clay 28-29 in Dark gray silty clay
	Primary Station		13:15	53.5	24		0-1 in Brown silty sand 1-23 in Dark gray silty clay 23-24 in Dark gray clay
	East Station		12:20	48.3	34		0-9 in Light brown sandy silt 9-34 in Gray silty clay
HSC003 (Field Duplicate)	West Station	9/30/2009	13:00	46.4	40	Piston Core	0-3 in Light brown silty sand 3-40 in Dark gray silty clay with light brown streaks
	Primary Station		13:20	53.5	37		0-1 in Light brown sandy silt 1-37 in Light brown silty clay
	East Station		12:40	48.3	42		0-4 in Light brown silty sand 4-42 in Dark gray clay
HSC004	West Station	10/7/2009	13:00	51.2	60	Piston Core	0-3 in Light brown sandy silt 3-37 in Light gray sandy clay 37-60 in Dark gray sandy clay
	Primary Station		12:40	55.9	16		0-8 in Light brown sandy silt 8-16 in Dark gray sandy silt
	East Station		12:30	50.8	55		0-0.5 in Light brown sandy silt 0.5-55 in Dark gray sandy clay
HSC005	West Station	10/7/2009	11:46	49.2	44	Piston Core	0-13 in Light brown sandy silt 13-44 in Dark gray sandy silt
	Primary Station		11:40	48.0	35		0-13 in Light brown sandy silt 13-35 in Dark gray sandy silt
	East Station		11:07	48.2	52		0-14 Dark brown sandy silt 14-45 in Dark gray sandy clay 45-52 in Light gray sandy clay
HSC006	West Station	10/7/2009	9:20	54.2	40	Piston Core	0-5 in Brown sandy silt with shell hash throughout 5-16 in Light brown sandy silt 16-40 in Light brown sandy clay
	Primary Station		9:45	55.1	4		0-4 in Light brown sandy clay with shell hash
	East Station		8:45	54.2	5		0-5 in Light brown sandy clay with shell hash
HSC007	West Station	10/7/2009	15:00	50.9	1	Ponar Grab	0-1 in Shell hash and sand
	Primary Station		15:10	50.1	3		0-3 in Shell hash with shell pieces
	East Station		15:15	49.1	5		0-5 in Shell hash with shell pieces

Appendix B Table 2 - Sample Date, Time, Water Depth , Sample Depth, and Sediment Description

Station		Sample Date	Sample Time	Water Depth (ft)[1]	Sample Depth (in)	Sample Method	Sediment Description
ODS001	North Station	10/7/2009	8:32	36.9	5	Ponar Grab	0-5 in Mottle light and dark gray fine silt
	Primary Station		9:02	36.5	4		0-4 in Light and dark gray and light brown fine silt
	South Station		9:38	37.5	5		0-5 in Light and dark gray fine silt

[1] Water Depth not tied to MLT, actual water depth at time of survey

Appendix C

ECS Environmental Chemistry Services

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DATA VALIDATION REPORT

CHARACTERIZATION OF POLYCHLORINATED DIBENZO-P-DIOXIN AND POLYCHLORONITED DIBENZO-FURAN CONTAMINANTS IN SEDIMENTS OF THE HOUSTON SHIP CHANNEL BETWEEN MORGAN'S POINT AND GALVESTON ISLAND IN GALVESTON BAY, TEXAS

SEPTEMBER 30 AND OCTOBER 7, 2009

Prepared by
Nancy K, Toole
ECS Environmental Chemistry Services

Prepared for
Benchmark Ecological Services, Inc.
Katy, Texas
December 14, 2009

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TABLE OF CONTENTS

ECS Environmental Chemistry Services

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1.0 Introduction

This Data Validation Report (DVR) contains the results of the data validation conducted for samples collected from the Houston Ship Channel between Morgan's Point and Galveston Island in Galveston Bay, Texas on September 30 and October 7, 2009. ECS Environmental Chemistry Services (ECS) reviewed sediment Polychlorinated Dibenzo-p-Dioxin and Polychlorinated Dibenzo-Furans (PCDD/F) sample data analyzed by Analytical Laboratory Services, Inc. (ALS) in Burlington, Ontario, Canada. The following samples are covered by this report:

SDG	LAB SAMPLE ID	FIELD SAMPLE ID	DATE COLL.	MEDIA	PARAMETER
0910014	0910014-01	HSC1-093009-001	09/30/2009	Sediment	D
	0910014-02	HSC2-093009-001	09/30/2009	Sediment	D
	0910014-03	HSC3-093009-001	09/30/2009	Sediment	D
	0910014-04	HSC3-093009-002	09/30/2009	Sediment	D
	0910014-05	EB1-093009-001	09/30/2009	Water	D
0910215	0910215-01	HSC4-100709-001	10/07/2009	Sediment	D
	0910215-02	HSC5-100709-001	10/07/2009	Sediment	D
	0910215-03	HSC6-100709-001	10/07/2009	Sediment	D
	0910215-04	HSC7-100709-001	10/07/2009	Sediment	D
	0910215-05	0051-100709-001	10/07/2009	Sediment	D
	0910215-06	EB-1-100709-002	10/07/2009	Water	D
	0910215-07	HSC4-100709-001 Dup	10/07/2009	Sediment	D

D= EPA Method 1613B PCDD/F by GC/MS-Isotopic Dilution

The following field QC samples are covered by this DVR:

DATA PACKAGE	LAB SAMPLE ID	FIELD QC SAMPLE ID	FIELD QC SAMPLE TYPE	ASSOCIATED SAMPLES
0910014	0910014-04	HSC3-093009-002	Field Duplicate	0910014-03B
	0910014-05	EB1-093009-001	Equipment Blank	0910014-01-04
0910215	0910215-01	HSC4-100709-001	MS/MSD	0910215-01
	0910215-06	EB-1-100709-002	Equipment Blank	0910215-01-05, 07
	0910215-07	HSC4-100709-001 Dup	Field Duplicate	0910215-01

Analytical data were evaluated for conformance to the requirements of the USEPA document entitled National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins and Chlorinated Dibenzofurans Data Review, September 2005 (NFG) and the Quality Assurance Project Plan (QAPP) generated for this project In August, 2009. The purpose of this investigation was to determine PCDD/F concentrations in sediment samples.

2.0 Data Validation Criteria

This DVR consists of the following elements as described in the NFG document:

PARAMETER/ METHOD	REVIEW ITEM	EVALUATION CRITERIA
PCDD/F by EPA Method 1613B	Holding Times/Preservation Requirements	NFG, Section I and Table 1
	System Performance Checks	NFG, Section III, IV, V, VI and Tables 3, A.1, A.3
	Initial Calibration	NFG, Section VII and Table A.5
	Calibration Verification	NFG, Section VIII
	Identification Criteria	NFG, Section IX
	Blanks	NFG, Section X
	Laboratory Control Sample (LCS) Analysis	NFG, Section XI and Table A.6
	Toxicity Equivalency Factor (TEF) and Isomer Specificity	NFG, Section XII
	Dilution by Addition of Solvent	NFG, Section XIII
	Dilution by Reextraction and Reanalysis	NFG, Section XIV
	Estimated Detection Limit (EDL) and Estimated Possible Concentration (EMPC)	NFG, Section XV
	Labeled Compound Recoveries	NFG, Section XVII and Table A.7
	Field Duplicates	See text

Results not meeting the evaluation criteria were documented in Section 3 of this report. The independent review of these items is covered in Section 3.0 of this DVR.

3.0 PCDD/F Data Review

For PCDD/F data, the following items are reviewed in this section:

- Holding Times/Preservation Requirements
- System Performance Checks
- Initial Calibration
- Calibration Verification
- Identification Criteria
- Blanks
- LCS Analysis
- TEF and Isomer Specificity
- Dilution by Addition of Solvent and Reextraction/Reanalysis
- EDL and EMPC
- Labeled Compound Recoveries
- Field Duplicates

The following sections specify the reasons for the data validation qualifiers that are presented in Appendix A.

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3.1 Holding Times/Preservation Requirements

The maximum holding time from date of collection to date of extraction for PCDD/F in sediment and aqueous samples that have been held at 4ºC is one year. The maximum holding time from date of extraction to date of analysis for PCDD/F in sediment and aqueous samples is 30 days. These holding times were met for all of the samples in this data set. None of the PCDD/F data were qualified based on holding times.

3.2 System Performance Checks

Elution windows were defined by a Window Performance Mix at the beginning of each 12-hour sequence. The 2, 3, 7, 8-substituted dioxins and furans met the RRT limits in Table A.3 of the NFG.

The chromatographic peak separation between the 2, 3, 7, 8-TCDD peak and its nearest neighbors was resolved with a valley of less than or equal to 25 percent at the beginning of each 12-hour sequence.

The mass spectrometer was tuned to a resolution of greater than or equal to 10,000 at the beginning and end of each 12-hour sequence.

For all calibrations, QC samples, and field samples, the absolute retention time (RT) for 1, 2, 3, 4-TCDD-$^{13}C_{12}$ was greater than 25.0 minutes on the DB5 column. The relative retention times of the analytes in the daily midpoint (CS3) calibration verification, fell into the ranges specified in Table A.3 of the NFG.

The RT in the daily CS3 verification standards were within 15 seconds of the absolute RT of the identical analyte in the initial calibration.

None of the PCDD/F data were qualified based on system performance checks.

3.3 Initial Calibration

Initial Calibrations were performed at the proper frequency and were performed with the numbers and concentrations of PCDD/F isomers specified in Table A.5 of the NFG.

Percent RSD values for native isomers were less than of equal to 20 percent for all isomers except for 1, 2, 3, 7, 8, 9-HxCDD and OCDF. Percent RSD values were less than of equal to 35 percent for native 1, 2, 3, 7, 8, 9-HxCDD and OCDF. Percent RSD values for the labeled isomers were less than 35 percent.

The ion abundance ratios in each calibration standard were within 15 percent of the limits set by the laboratory.

The signal to noise ratios for each quantitation for all isomers were not greater than or equal to 10:1.

None of the PCDD/F data were qualified based on initial calibration data.

3.4 Continuing Calibration

Continuing Calibrations were performed at the proper frequency and were performed with the numbers and concentrations of PCDD/F isomers specified in Table A.5 of the NFG.

Ion abundance ratios were within the 15 percent window specified by the laboratory.

The absolute retention time of internal standard $^{13}C_{12}$-1,2,3,4-TCDD was greater than 25 minutes on the DB5 MS column.

Internal standards in the calibration verification were within 15 seconds of the retention times in the initial calibration.

The relative retention times met the criteria in Table A.3 of the NFG.

Percent differences for RRF in the calibration verification were within 35 percent of the mean values established in the initial calibration.

Percent differences for RRT for the calibration verification were within 20 percent of the mean values established in the initial calibration.

The signal to noise ratios for each compound in the calibration verification were not greater than or equal to 10:1.

None of the PCDD/F data were qualified based on continuing calibration data.

3.5 Identification Criteria

For positive identification, retention times of the peak maxima for the two quantitation ions were within 2 seconds.

The relative retention times for 2,3,7,8 substituted isomers were within the -1 to +3 seconds of the retention time of the corresponding $^{13}c_{12}$ labeled isomer of the sequence. For those native analytes without a corresponding labeled isomer, the relative retention times were within 0.005 of the relative retention time observed in the daily CS3 run.

PCDD/F data was reported down to a 2.5:1 signal to noise ratio for each isomer grouping. Labeled and internal standard ions and calibration standard solutions for PCDD/F isomers were at least 10 times above background noise

The ion abundance ratios in each calibration standard were set by the laboratory as follows:

NO. CHLORINE ATOMS	M/Z FORMING RATIO	THEORETICAL RATIO	LOWER CONTROL LIMIT	UPPER CONTROL LIMIT
4[1]	M/(M+2)	0.77	0.65	0.89
5	(M+2)/(M+4)	1.55	1.32	1.78
5	M/(M+2)	0.63	0.54	0.72
6	(M+2)/(M+4)	1.24	1.05	1.43
6	M/(M+2)	0.51	0.43	0.59
7	M/(M+2)	0.44	0.37	0.51
7	(M+2)/(M+4)	1.05	0.88	1.20
7	(M+4)/(M+6)	1.88	1.60	2.16
8	(M+2)/(M+4)	0.89	0.76	1.02

1-Does not apply to $^{37}C_4$-2,3,7,8-TCDD (cleanup standard)

These ion ratios were met with the following exceptions:

SDG	SAMPLE ID	PCDD/F	ION ABUND. RATIO	ACCEPTANCE RANGE
0910014	0910014-01	1,2,3,6,7,8-HxCDD	1.81	1.05-1.43
		2,3,4,7,8-PeCDF	1.28	1.32-1.78
		1,2,3,7,8,9-HxCDF	0.84	0.43-0.59
	0910014-02	1,2,3,7,8-PeCDD	0.75	0.54-0.72
		1,2,3,7,8,9-HxCDD	1.81	1.05-1.43
		1,2,3,6,7,8- HxCDF	1.69	1.05-1.43
		2,3,4,6,7,8- HxCDF	0.99	0.43-0.59
		1,2,3,7,8,9 HxCDF	1.73	1.05-1.43
		1,2,3,4,7,8,9 HpCDF	1.49	1.60-2.16
	0910014-03	1,2,3,4,7,8-HxCDD	1.02	1.05-1.43
		1,2,3,4,7,8,9 HpCDF	1.46	1.05-1.43
	0910014-04	1,2,3,6,7,8-HxCDF	1.02	
		1,2,3,7,8, 9-HxCDF	1.47	
	0910014-05	2,3,4,7,8-PeCDF	1.03	1.32-1.78
		1,2,3,4,7,8-HxCDF	1.92	1.05-1.43
		1,2,3,6,7,8-HxCDF	1.54	1.05-1.43
		2,3,4,6,7,8-HxCDF	0.92	0.43-0.59
		1,2,3,4,6,7,8-HpCDF	1.25	1.60-2.16
		OCDF	1.08	0.76-1.02
0910215	0910215-01	1,2,3,6,7,8-HxCDF	1.02	1.05-1.43
		1,2,3,4,7,8,9-HpCDF	1.25	1.60-2.16
	0910215-02	1,2,3,4,7,8-HxCDF	0.93	1.05-1.43
		1,2,3,7,8,9 HxCDF	0.98	1.05-1.43
		1,2,3,4,7,8,9-HpCDF	2.21	1.60-2.16
	0910215-03	1,2,3,4,7,8-HxCDF	1.59	1.05-1.43
		1,2,3,7,8,9 HxCDF	1.46	1.05-1.43
		1,2,3,4,7,8,9-HpCDF	1.42	1.60-2.16
	0910215-04	2,3,4,7,8-PeCDF	1.10	1.32-1.78
		1,2,3,4,7,8-HxCDF	2.41	1.05-1.43
		1,2,3,6,7,8-HxCDF	0.92	1.05-1.43
		2,3,4,6,7,8-HxCDF	1.30	0.43-0.59
		1,2,3,4,6,7,8-HpCDF	1.27	1.60-2.16
	0910215-05	1,2,3,4,7,8,9-HpCDF	1.38	1.60-2.16
	0910215-06	1,2,3,4,6,7,8-HpCDD	1.39	0.88-1.20

SDG	SAMPLE ID	PCDD/F	ION ABUND. RATIO	ACCEPTANCE RANGE
		OCDD	0.74	0.76-1.02
0910215	0910215-06	1,2,3,4,7,8-HxCDF	1.63	1.05-1.43
	0910215-07	2,3,4,7,8-PeCDF	1.20	1.32-1.78
		1,2,3,7,8,9 HxCDF	1.60	1.05-1.43
		1,2,3,4,7,8,9-HpCDF	1.51	1.60-2.16

The compounds in the samples listed above were qualified as unusable with a "R-TUN" qualifier based on the ion abundance ratio being out of acceptance range. The TEQ concentrations derived from the individual compounds were qualified as estimated with J qualifiers.

3.6 Blanks

One method blank was analyzed with each analytical batch. One equipment blank was analyzed for each day samples were collected. The criteria of no detections of PCDD/F isomers above the CRQL for all isomers except OCDD and OCDF and no detection of OCDD or OCDF above 3 times the CRQL were met for the associated blanks. None of the PCDD/F data were qualified based on blank data.

3.7 Laboratory Control Samples

The LCS review criteria for PCDD/F isomers are as follows:

PCDD/F	ACCURACY (%R)
2,3,7,8-TCDD	67-158
2,3,7,8-TCDF	75-158
1,2,3,7,8-PeCDD	70-142
1,2,3,7,8-PeCDF	80-134
2,3,4,7,8-PeCDF	68-160
1,2,3,4,7,8-HxCDD	70-164
1,2,3,6,7,8-HxCDD	76-134
1,2,3,7,8,9-HxCDD	64-162
1,2,3,4,7,8-HxCDF	72-134
1,2,3,6,7,8-HxCDF	84-130
1,2,3,7,8,9-HxCDF	78-130
2,3,4,6,7,8-HxCDF	70-156
1,2,3,4,6,7,8-HpCDD	70-140
1,2,3,4,6,7,8-HpCDF	82-132
1,2,3,4,7,8,9-HpCDF	78-138
OCDD	78-144
OCDF	63-170

One LCS was analyzed with every analytical batch. These criteria were met for all the LCS results in this data set with the following exceptions:

SDG	LCS ID	PCDD/F	LCS %R	CONT LIMIT	ASSOC. SAMPLES
0910014	LCS-1012582-2	1,2,3,6,7,8-HxCDF	83	84-130	0910014-01, 02, 04
	LCS-1019619-2	1,2,3,6,7,8-HxCDF	81	84-130	0910014-03

The associated samples were qualified as follows:

	Detected results	Non-Detected Results
% R greater than Upper Limit	J	No qualification
% R less than Lower Limit but greater than 10%	J	R
% R less than 10%	R	R

3.8 Toxicity Equivalency Factors (TEF) and Isomer Specificity

TEF calculations were properly performed as specified in the QAPP using a factor of one half of the EDL for non-detected isomers. None of the PCDD/F data were qualified based on TEF calculation errors.

3.9 Dilution by Addition of Solvent and Reextraction and Reanalysis

All reported sample values were within the calibration range. If samples were diluted internal standard calculations were performed properly. None of the PCDD/F data were qualified based on dilution calculation errors.

3.10 Second Column Confirmation

Second column confirmation was not required for this analytical run due to the fact that the DB5 MS column achieved resolution of 2,3,7,8-TCDF based on the analysis of a Column Resolution Mix. None of the PCDD/F data were qualified based on second column confirmation procedures.

3.11 Estimated Detection Limit (EDL) and Estimated Maximum Possible Concentration (EMPC)

EDLs and EMPC were properly calculated. EDLs were reported for each undetected analyte. EDLs were less than the CRQL except in cases of dilution. Analytes reported as EMPCs meet all identification criteria, except ion abundance ratios, as specified in Section IX of the NFG. None of the PCDD/F data were qualified based on EDL or EMPC calculations.

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3.12 Labeled Compound Recoveries

The labeled compound percent recoveries fell within the criteria specified in Table A.7 of the NFG. S/N ratios were greater than or equal to 10:1 for labeled compounds. Ion abundance ratios for labeled compounds were within the required limits. None of the PCDD/F data were qualified based on labeled compound results.

3.13 Field Duplicates

For solid matrix samples the Relative Percent Differences (RPD) was equal to or less than 50%. None of the solid matrix volatile data were qualified based on field duplicate data.

4.0 Overall Assessment of Data

The data covered by this report are acceptable for use in meeting project objectives as qualified based on the following data quality assurance objectives:

- *Accuracy* as measured through analysis of Laboratory Fortified Blank (LFB) samples and Laboratory Fortified Matrix/Duplicate (LFM/D) samples. Since 99 %of these samples were within the applicable acceptance ranges, the overall level of accuracy is considered acceptable.
- *Precision* as measured by the analysis of laboratory and field duplicates were within applicable acceptance ranges. Since 100 % of these samples were within the applicable acceptance ranges, overall precision is considered acceptable.
- *Completeness* measured as the ratio of the number of valid analytical results to the total number of analytical results requested meets the goal of 90% for solid matrix samples. Overall completeness is considered acceptable.
- *Representativeness* as measured by comparing the results obtained for the field duplicate pairs, use of sampling procedures contained in the QAPP and relevant SOPs is considered acceptable.

5.0 Data Usability Relative to Project Objectives

The purpose of this investigation was to determine dioxin concentrations in sediment samples. This was accomplished by analyzing samples for the COCs. The following is a discussion of qualified data and the potential impacts these qualified results have on meeting project objectives.

The following analysis discusses the potential effects of biases on the usability of the data.

PCDD/F Accuracy – The following ion abundance ratios were did not meet data review criteria:

SDG	SAMPLE ID	PCDD/F	ION ABUND. RATIO	ACCEPT. RANGE	Sample result was less than 10 times the EDL	TEF
0910014	0910014-01	1,2,3,6,7,8-HxCDD	1.81	1.05-1.43		0.1
		2,3,4,7,8-PeCDF	1.28	1.32-1.78	X	0.5
		1,2,3,7,8,9-HxCDF	0.84	0.43-0.59	X	0.1
	0910014-02	1,2,3,7,8-PeCDD	0.75	0.54-0.72	X	0.5
		1,2,3,7,8,9-HxCDD	1.81	1.05-1.43		0.1
		1,2,3,6,7,8- HxCDF	1.69	1.05-1.43		0.1
		2,3,4,6,7,8- HxCDF	0.99	0.43-0.59		0.1
		1,2,3,7,8,9 HxCDF	1.73	1.05-1.43	X	0.1
		1,2,3,4,7,8,9 HpCDF	1.49	1.60-2.16	X	0.01
	0910014-03	1,2,3,4,7,8-HxCDD	1.02	1.05-1.43	X	0.1
		1,2,3,4,7,8,9 HpCDF	1.46	1.05-1.43		0.01
	0910014-04	1,2,3,6,7,8-HxCDF	1.02		X	0.1
		1,2,3,7,8, 9-HxCDF	1.47		X	0.1
	0910014-05	2,3,4,7,8-PeCDF	1.03	1.32-1.78	X	0.5
		1,2,3,4,7,8-HxCDF	1.92	1.05-1.43	X	0.1
		1,2,3,6,7,8-HxCDF	1.54	1.05-1.43	X	0.1
		2,3,4,6,7,8-HxCDF	0.92	0.43-0.59	X	0.1
		1,2,3,4,6,7,8-HpCDF	1.25	1.60-2.16	X	0.01
		OCDF	1.08	0.76-1.02	X	0.001
0910215	0910215-01	1,2,3,6,7,8-HxCDF	1.02	1.05-1.43	X	0.1
		1,2,3,4,7,8,9-HpCDF	1.25	1.60-2.16	X	0.01
	0910215-02	1,2,3,4,7,8-HxCDF	0.93	1.05-1.43	X	0.1
		1,2,3,7,8,9 HxCDF	0.98	1.05-1.43	X	0.1
		1,2,3,4,7,8,9-HpCDF	2.21	1.60-2.16	X	0.01
	0910215-03	1,2,3,4,7,8-HxCDF	1.59	1.05-1.43	X	0.1
		1,2,3,7,8,9 HxCDF	1.46	1.05-1.43	X	0.1
		1,2,3,4,7,8,9-HpCDF	1.42	1.60-2.16	X	0.1
	0910215-04	2,3,4,7,8-PeCDF	1.10	1.32-1.78	X	0.5
		1,2,3,4,7,8-HxCDF	2.41	1.05-1.43	X	0.1
		1,2,3,6,7,8-HxCDF	0.92	1.05-1.43	X	0.1
		2,3,4,6,7,8-HxCDF	1.30	0.43-0.59	X	0.1
		1,2,3,4,6,7,8-HpCDF	1.27	1.60-2.16	X	0.01
	0910215-05	1,2,3,4,7,8,9-HpCDF	1.38	1.60-2.16	X	0.01
	0910215-06	1,2,3,4,6,7,8-HpCDD	1.39	0.88-1.20	X	0.01
		OCDD	0.74	0.76-1.02	X	0.001
		1,2,3,4,7,8-HxCDF	1.63	1.05-1.43	X	0.1
	0910215-07	2,3,4,7,8-PeCDF	1.20	1.32-1.78	X	0.5

SDG	SAMPLE ID	PCDD/F	ION ABUND. RATIO	ACCEPT. RANGE	Sample result was less than 10 times the EDL	TEF
0910215	0910215-07	1,2,3,7,8,9 HxCDF	1.60	1.05-1.43	X	0.1
		1,2,3,4,7,8,9-HpCDF	1.51	1.60-2.16	X	0.01

Ion Abundance ratios were generally out of acceptance ranges, when the concentrations were close to the Estimated Detection Limits (EDLs) as shown in the previous table. Since the EDLs were based on a 2.5:1 signal to background noise level, concentrations approaching the EDL were impacted by noise interferences in one or both of the ions, resulting in ion abundance ratios that were out of acceptance limits as would be expected. The data for compounds that did not meet ion abundance ratios were rejected with "R qualifiers added to the out of acceptance limit compounds as required by NFG and "<" qualifiers were added by the lab to the data. However, since the result were generally low in concentration and/ or were not in compounds with high TEF factors, the impact on the interpretation of the final TEQ concentration is negligible.

The following LCS were out of control limits:

SDG	LCS ID	COMPOUND	LCS %R	CONT LIMIT	ASSOC. SAMPLES
0910014	LCS-1012582-2	1,2,3,6,7,8-HxCDF	83	84-130	0910014-01, 02, 04
	LCS-1019619-2	1,2,3,6,7,8-HxCDF	81	84-130	0910014-03

The LCS results did not impact the interpretation of the associated data because the LCS recoveries were just barely out of data review criteria.

6.0 Conclusions

The chemical data covered by this Data Usability Report are considered usable for meeting the project objective of determining the PCDD/F concentrations in sediment samples with the qualifications presented in this report.

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APPENDIX A

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910014-01B (HSC1-093009-001)**	Sampling Date	30-Sep-09	Approved:
ALS Sample ID	L826061-1	Extraction Date	05-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	8.52 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	58.0%	21-Oct-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091009B-10
Run Date	09-Oct-09 23:50
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5MS #US8942343H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:09	1.84	0.048	
1,2,3,7,8-PeCDD	0.5	31:29	0.871	0.094	J - ICAL
1,2,3,4,7,8-HxCDD	0.1	33:39	1.87	0.24	
1,2,3,6,7,8-HxCDD	0.1	33:43	3.90	0.24	
1,2,3,7,8,9-HxCDD	0.1	33:52	<5.8	0.24	R - R-TUN
1,2,3,4,6,7,8-HpCDD	0.01	35:23	140	2.7	
OCDD	0.001	36:58	3120	0.57	
2,3,7,8-TCDF	0.1	24:57	3.45	0.077	
1,2,3,7,8-PeCDF	0.05	30:23	0.564	0.065	J - ICAL
2,3,4,7,8-PeCDF	0.5	31:15	<0.48	0.068	R - ICAL, TUN
1,2,3,4,7,8-HxCDF	0.1	33:13	1.23	0.051	
1,2,3,6,7,8-HxCDF	0.1	33:17	0.771	0.051	J - LCS, ICAL
2,3,4,6,7,8-HxCDF	0.1	33:35	0.655	0.058	J - ICAL
1,2,3,7,8,9-HxCDF	0.1	34:04	<0.21	0.065	R - ICAL, TUN
1,2,3,4,6,7,8-HpCDF	0.01	34:49	10.2	0.30	
1,2,3,4,7,8,9-HpCDF	0.01	35:41	0.990	0.30	J - ICAL
OCDF	0.001	37:06	86.2	0.15	

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:07	73	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:29	70	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:39	78	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:42	68	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:23	70	23-140
13C12-OCDD	4000	36:58	56	17-157
13C12-2,3,7,8-TCDF	2000	24:55	70	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:22	75	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:14	67	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:12	81	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:17	74	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:34	68	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:02	72	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:49	47	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:41	62	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:09	73	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	12	22.9	0.048
Total-PeCDD	8	32.8	0.094
Total-HxCDD	6	173	0.24
Total-HpCDD	2	518	2.7
Total-TCDF	15	10.7	0.077
Total-PeCDF	9	3.83	0.068
Total-HxCDF	11	9.21	0.065
Total-HpCDF	5	23.4	0.30

Toxic Equivalency - NATO	**pg/g**	
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~0.21~~	
Mid Bound PCDD/F TEQ (ND=0.5DL)	9.05	J ECS
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~9.05~~	

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF Indicates the Toxic Equivalency Factor
TEQ Indicates the Toxic Equivalency

J Indicates that a target analyte was detected below the calibrated range.
R Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910014-02B (HSC2-093009-001)**	Sampling Date	30-Sep-09	Approved:
ALS Sample ID	L826061-2	Extraction Date	05-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	8.78 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	56.6%	21-Oct-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**	**Run 2**
Filename	1-091009B-11	1-091010A-07
Run Date	10-Oct-09 00:32	10-Oct-09 18:57
Final Volume	20 uL	20 uL
Dilution Factor	1	5
Analysis Units	pg/g	pg/g
Instrument - Column	HRMS-1 DB5MS #US8942343H	HRMS-1 DB5MS #US8942343H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:09	0.857	0.044		[illegible]	[illegible]	[illegible]	[illegible]
1,2,3,7,8-PeCDD	0.5	31:30	<0.71	0.14	J,R	31:29	<0.99	0.36	J,R
1,2,3,4,7,8-HxCDD	0.1	33:40	2.28	0.32		33:39	1.36	0.36	J
1,2,3,6,7,8-HxCDD	0.1	33:42	3.37	0.32		33:42	3.98	0.40	J
1,2,3,7,8,9-HxCDD	0.1	33:52	<6.2	0.32	R	[illegible]	[illegible]	[illegible]	R
1,2,3,4,6,7,8-HpCDD	0.01	[illegible]				35:22	143	1.8	
OCDD	0.001	36:58	2980	0.23		[illegible]	[illegible]	[illegible]	
2,3,7,8-TCDF	0.1	24:58	1.81	0.049		24:55	1.82	0.31	
1,2,3,7,8-PeCDF	0.05	30:23	0.388	0.055	J	30:21	<0.57	0.19	J,R
2,3,4,7,8-PeCDF	0.5	31:15	0.426	0.057	J	31:14	<0.34	0.19	J,R
1,2,3,4,7,8-HxCDF	0.1	33:13	0.737	0.059	J	33:12	<1.0	0.18	J,R
1,2,3,6,7,8-HxCDF	0.1	33:17	<0.51	0.056	J,R	33:16	0.749	0.18	R
2,3,4,6,7,8-HxCDF	0.1	33:35	<0.44	0.065	J,R	33:34	0.745	0.20	R
1,2,3,7,8,9-HxCDF	0.1	34:03	<0.17	0.074	J,R	34:02	0.500	0.23	R
1,2,3,4,6,7,8-HpCDF	0.01	[illegible]				34:48	7.58	0.41	
1,2,3,4,7,8,9-HpCDF	0.01	[illegible]			J,R	35:40	0.865	0.62	J,R
OCDF	0.001	37:06	29.9	0.22		[illegible]	[illegible]	[illegible]	

Extraction Standards	**pg**		**% Rec**	**Limits**		**% Rec**
13C12-2,3,7,8-TCDD	2000	26:07	68	25-164	26:04	72
13C12-1,2,3,7,8-PeCDD	2000	31:29	61	25-181	31:27	71
13C12-1,2,3,4,7,8-HxCDD	2000	33:39	59	32-141	33:38	74
13C12-1,2,3,6,7,8-HxCDD	2000	33:42	69	28-130	33:41	78
13C12-1,2,3,4,6,7,8-HpCDD	2000	[illegible]	[illegible]	23-140	35:22	64
13C12-OCDD	4000	36:57	42	17-157	[illegible]	[illegible]
13C12-2,3,7,8-TCDF	2000	24:56	70	24-169	24:53	76
13C12-1,2,3,7,8-PeCDF	2000	30:22	66	24-185	30:21	76
13C12-2,3,4,7,8-PeCDF	2000	31:14	59	21-178	31:13	73
13C12-1,2,3,4,7,8-HxCDF	2000	33:12	71	26-152	33:11	76
13C12-1,2,3,6,7,8-HxCDF	2000	33:17	68	26-123	33:16	75
13C12-2,3,4,6,7,8-HxCDF	2000	33:35	61	29-147	33:33	71
13C12-1,2,3,7,8,9-HxCDF	2000	34:02	63	28-136	34:01	72
13C12-1,2,3,4,6,7,8-HpCDF	2000			28-143	34:48	67
13C12-1,2,3,4,7,8,9-HpCDF	2000			26-138	35:39	58

Cleanup Standard	**pg**					
37Cl4-2,3,7,8-TCDD	40	26:09	130	35-197	26:07	141

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**	# peaks	Conc. pg/g	EDL pg/g
Total-TCDD	13	23.1	0.044	7	15.8	0.16
Total-PeCDD	7	34.4	0.14	6	35.6	0.36
Total-HxCDD	6	196	0.32	5	195	0.40
Total-HpCDD	[illegible]	[illegible]	[illegible]	**2**	**557**	**1.8**
Total-TCDF	16	6.89	0.049	4	[illegible]	[illegible]
Total-PeCDF	7	2.75	0.057	[illegible]	1.32	0.15
Total-HxCDF	6	5.58	0.074	[illegible]	[illegible]	[illegible]
Total-HpCDF	[illegible]	[illegible]	[illegible]	4	16.2	0.62

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~6.43~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	7.52
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~7.52~~

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency

J indicates that a **target analyte** was detected below the calibrated **range.**
R Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910014-03B (HSC3-093009-001)**	Sampling Date	30-Sep-09	Approved:
ALS Sample ID	L826061-3R	Extraction Date	18-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	5.55 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	46.2%	21-Oct-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091019A-11
Run Date	19-Oct-09 23:00
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5MS #US8942343H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:18	0.500	0.083	
1,2,3,7,8-PeCDD	0.5	31:33	1.06	0.20	J - ICAL
1,2,3,4,7,8-HxCDD	0.1	33:42	<1.9	0.50	& R - TUN
1,2,3,6,7,8-HxCDD	0.1	33:45	2.91	0.51	
1,2,3,7,8,9-HxCDD	0.1	33:54	5.11	0.51	
1,2,3,4,6,7,8-HpCDD	0.01	35:26	98.2	2.6	
OCDD	0.001	37:02	1980	1.1	
2,3,7,8-TCDF	0.1	25:04	1.07	0.092	
1,2,3,7,8-PeCDF	0.05	30:26	0.911	0.15	J - ICAL
2,3,4,7,8-PeCDF	0.5	31:18	0.904	0.14	J - ICAL
1,2,3,4,7,8-HxCDF	0.1	33:15	1.15	0.16	J - ICAL
1,2,3,6,7,8-HxCDF	0.1	33:19	1.04	0.15	& J - ICAL, LCS
2,3,4,6,7,8-HxCDF	0.1	33:37	0.981	0.16	J - ICAL
1,2,3,7,8,9-HxCDF	0.1	34:05	0.911	0.20	J - ICAL
1,2,3,4,6,7,8-HpCDF	0.01	34:52	4.41	0.25	
1,2,3,4,7,8,9-HpCDF	0.01	35:44	<1.1	0.38	~~J,R~~ R - ICAL, TUN
OCDF	0.001	37:10	16.3	0.37	

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:15	66	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:32	65	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:42	61	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:45	74	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:26	58	23-140
13C12-OCDD	4000	37:02	39	17-157
13C12-2,3,7,8-TCDF	2000	25:03	69	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:26	69	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:17	65	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:15	71	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:19	69	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:37	65	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:05	65	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:52	58	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:44	54	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:17	67	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	8	15.6	0.083
Total-PeCDD	5	25.9	0.20
Total-HxCDD	8	146	0.51
Total-HpCDD	2	378	2.6
Total-TCDF	9	3.19	0.092
Total-PeCDF	3	2.22	0.15
Total-HxCDF	5	5.79	0.20
Total-HpCDF	3	8.31	0.38

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~5.97~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	6.07
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~6.07~~

J

ECS

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
J	indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910014-04B (HSC3-093009-002)**	Sampling Date	30-Sep-09	Approved:
ALS Sample ID	L826061-4	Extraction Date	05-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	10.91 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	46.4%	21-Oct-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**	**Run 2**
Filename	1-091009B-13	1-091010A-08
Run Date	10-Oct-09 01:58	10-Oct-09 19:40
Final Volume	20 uL	20 uL
Dilution Factor	1	5
Analysis Units	pg/g	pg/g
Instrument - Column	HRMS-1 DB5MS #US8942343H	HRMS-1 DB5MS #US8942343H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:08	0.390	0.038		[illegible]	[illegible]	[illegible]	J
1,2,3,7,8-PeCDD	0.5	31:30	0.517	0.057	J-ICAL	31:28	<0.64	0.23	J,R
1,2,3,4,7,8-HxCDD	0.1	33:40	1.14	0.16		33:39	1.31	0.34	J
1,2,3,6,7,8-HxCDD	0.1	33:43	1.97	0.17		33:42	2.52	0.34	J
1,2,3,7,8,9-HxCDD	0.1	33:51	3.56	0.17		[illegible]	[illegible]	[illegible]	
1,2,3,4,6,7,8-HpCDD	0.01	[illegible]	[illegible]	[illegible]		35:22	85.4	2.1	
OCDD	0.001	36:58	1670	0.29		[illegible]	[illegible]	[illegible]	
2,3,7,8-TCDF	0.1	24:57	0.788	0.045		24:54	0.555	0.16	
1,2,3,7,8-PeCDF	0.05	30:23	0.228	0.043	J-ICAL	NotFnd	<0.15	0.15	U
2,3,4,7,8-PeCDF	0.5	31:14	0.215	0.046	J-ICAL	31:15	0.259	0.15	J
1,2,3,4,7,8-HxCDF	0.1	33:13	0.382	0.033	J-ICAL	33:12	0.570	0.11	J
1,2,3,6,7,8-HxCDF	0.1	33:17	<0.30	0.032	J,R	33:16	<0.29	0.11	J,R
2,3,4,6,7,8-HxCDF	0.1	33:35	0.281	0.038	J	33:34	0.403	0.12	J
1,2,3,7,8,9-HxCDF	0.1	34:03	<0.095	0.042	J,R	NotFnd	<0.15	0.15	U
1,2,3,4,6,7,8-HpCDF	0.01	[illegible]	[illegible]	[illegible]		34:48	4.05	0.29	J
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd		0.31	U	35:40	<0.40	0.39	J,R
OCDF	0.001	37:05	13.6	0.11		[illegible]	[illegible]	[illegible]	
Extraction Standards	**pg**		**% Rec**	**Limits**			**% Rec**		
13C12-2,3,7,8-TCDD	2000	26:08	75	25-164		26:04	[illegible]		
13C12-1,2,3,7,8-PeCDD	2000	31:29	70	25-181		31:27	72		
13C12-1,2,3,4,7,8-HxCDD	2000	33:39	70	32-141		33:39	78		
13C12-1,2,3,6,7,8-HxCDD	2000	33:42	73	28-130		33:41	89		
13C12-1,2,3,4,6,7,8-HpCDD	2000	[illegible]	[illegible]	23-140		35:21	70		
13C12-OCDD	4000	36:57	45	17-157		[illegible]	[illegible]		
13C12-2,3,7,8-TCDF	2000	24:56	76	24-169		24:52	76		
13C12-1,2,3,7,8-PeCDF	2000	30:21	76	24-185		30:21	78		
13C12-2,3,4,7,8-PeCDF	2000	31:13	65	21-178		31:13	73		
13C12-1,2,3,4,7,8-HxCDF	2000	33:12	73	26-152		33:11	83		
13C12-1,2,3,6,7,8-HxCDF	2000	33:16	72	26-123		33:15	76		
13C12-2,3,4,6,7,8-HxCDF	2000	33:35	65	29-147		33:34	72		
13C12-1,2,3,7,8,9-HxCDF	2000	34:02	69	28-136		34:01	72		
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:40	68	28-143		34:48	68		
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:40	68	26-138		35:39	68		
Cleanup Standard	**pg**								
37Cl4-2,3,7,8-TCDD	40	26:09	71	35-197		26:06	65		

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	14	15.6	0.038	9	13.4	0.12
Total-PeCDD	7	23.4	0.057	5	24.9	0.23
Total-HxCDD	8	133	0.17	6	149	0.34
Total-HpCDD	[illegible]	[illegible]	[illegible]	2	329	2.1
Total-TCDF	15	4.10	0.045	[illegible]	[illegible]	[illegible]
Total-PeCDF	6	1.77	0.046	5	1.40	0.15
Total-HxCDF	7	3.09	0.042	5	[illegible]	[illegible]
Total-HpCDF	3	[illegible]	[illegible]	3	8.29	0.39

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~4.10~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	4.20
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~4.20~~

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
U	Indicates that this compound was not detected above the MDL.
J	indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910014-05A (EB1-093009-001)**	Sampling Date	30-Sep-09	Approved:
ALS Sample ID	L826061-5	Extraction Date	20-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	0.975 Litres	--e-signature--
Analysis Type	Sample	Percent Moisture	n/a	23-Oct-09
Sample Matrix	WATER	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091023A-05
Run Date	23-Oct-09 12:10
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/L
Instrument - Column	HRMS-1 DB5 #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/L**	**EDL pg/L**	**Flags**	
2,3,7,8-TCDD	1	NotFnd	<0.37	0.37	U	
1,2,3,7,8-PeCDD	0.5	NotFnd	<0.42	0.42	U	
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.51	0.51	U	
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.51	0.51	U	
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.51	0.51	U	
1,2,3,4,6,7,8-HpCDD	0.01	NotFnd	<0.81	0.81	U	
OCDD	0.001	37:22	10.1	0.46	J,B	J - ICAL
2,3,7,8-TCDF	0.1	23:43	<0.43	0.43	U	J - ICAL
1,2,3,7,8-PeCDF	0.05	NotFnd	<0.26	0.26	U	
2,3,4,7,8-PeCDF	0.5	30:39	<0.39	0.25	J,R	R, TUN, ICAL
1,2,3,4,7,8-HxCDF	0.1	33:20	<0.82	0.29	J,R	R, TUN, ICAL, Q
1,2,3,6,7,8-HxCDF	0.1	33:24	<0.77	0.26	J,R	R, TUN, ICAL, Q
2,3,4,6,7,8-HxCDF	0.1	33:53	<0.36	0.30	J,R	R, TUN, ICAL, Q
1,2,3,7,8,9-HxCDF	0.1	34:22	0.629	0.36	J,B	
1,2,3,4,6,7,8-HpCDF	0.01	35:24	<0.47	0.36	J,R	R, TUN, ICAL
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<0.53	0.53	U	
OCDF	0.001	37:25	<2.0	0.40	J,R	R, TUN, ICAL

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	25:08	45	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:02	42	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:59	65	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	34:03	60	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:56	57	23-140
13C12-OCDD	4000	37:22	42	17-157
13C12-2,3,7,8-TCDF	2000	23:41	57	24-169
13C12-1,2,3,7,8-PeCDF	2000	29:48	50	24-185
13C12-2,3,4,7,8-PeCDF	2000	30:39	47	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:19	73	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:25	74	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:53	69	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:22	68	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	35:23	66	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	36:07	60	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	25:10	55	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/L**	**EDL pg/L**
Total-TCDD	1	1.05	0.37
Total-PeCDD	6	6.91	0.42
Total-HxCDD	1	21.3	0.51
Total-HpCDD	0	<0.81	0.81
Total-TCDF	5	2.95	0.43
Total-PeCDF	2	1.13	0.26
Total-HxCDF	5	3.56	0.36
Total-HpCDF	1	0.553	0.53

Toxic Equivalency - NATO	**pg/L**	
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~0.0730~~	
Mid Bound PCDD/F TEQ (ND=0.5DL)	0.871	J ECS
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~1.27~~	

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
U	Indicates that this compound was not detected above the MDL.
J	indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-01B (HSC4-100709-001) Reextract**	Sampling Date	7-Oct-09	Approved:
ALS Sample ID	L830159-6R	Extraction Date	04-Nov-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	8.44 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	44.2%	06-Nov-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091105B-13
Run Date	06-Nov-09 01:23
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5ms #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:04	0.257	0.083	
1,2,3,7,8-PeCDD	0.5	31:27	0.417	0.086	J
1,2,3,4,7,8-HxCDD	0.1	33:38	1.21	0.26	M
1,2,3,6,7,8-HxCDD	0.1	33:42	1.68	0.28	M
1,2,3,7,8,9-HxCDD	0.1	33:50	3.19	0.27	
1,2,3,4,6,7,8-HpCDD	0.01	35:23	75.3	1.8	
OCDD	0.001	36:58	1530	0.58	
2,3,7,8-TCDF	0.1	24:53	0.598	0.060	
1,2,3,7,8-PeCDF	0.05	30:19	0.213	0.070	J
2,3,4,7,8-PeCDF	0.5	31:12	0.253	0.063	M,J,B
1,2,3,4,7,8-HxCDF	0.1	33:11	0.471	0.058	M,J
1,2,3,6,7,8-HxCDF	0.1	33:15	<0.35	0.060	M,J,R
2,3,4,6,7,8-HxCDF	0.1	33:34	0.257	0.062	J
1,2,3,7,8,9-HxCDF	0.1	34:02	0.0989	0.071	J
1,2,3,4,6,7,8-HpCDF	0.01	34:49	3.30	0.11	
1,2,3,4,7,8,9-HpCDF	0.01	35:41	<0.33	0.14	J,R
OCDF	0.001	37:06	11.4	0.16	

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:02	64	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:27	60	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:38	70	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:41	73	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:22	63	23-140
13C12-OCDD	4000	36:58	48	17-157
13C12-2,3,7,8-TCDF	2000	24:51	70	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:19	61	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:12	63	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:11	75	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:15	71	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:33	73	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:01	73	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:49	58	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:40	60	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:04	60	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	11	14.9	0.083
Total-PeCDD	8	21.6	0.086
Total-HxCDD	7	115	0.28
Total-HpCDD	2	271	1.8
Total-TCDF	6	1.65	0.060
Total-PeCDF	9	2.06	0.070
Total-HxCDF	7	3.39	0.071
Total-HpCDF	3	7.46	0.14

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~3.68~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	3.72
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~3.72~~

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalenc
M Indicates that a peak has been manually integrated

J Indicates that a target analyte was detected below the calibrated range
R Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion
B Indicates that this target was detected in the blank at greater than 10% of the sample concentration

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-02B (HSC5-100709-001) Duplicate**	Sampling Date	7-Oct-09		Approved:
ALS Sample ID	WG1019899-4	Extraction Date	22-Oct-09		*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	12.63	grams	--e-signature--
Analysis Type	Sample	Percent Moisture	38.6%		06-Nov-09
Sample Matrix	QC	Split Ratio	1		

Run Information	**Run 1**
Filename	1-091102A-11
Run Date	02-Nov-09 23:20
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5ms #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:07	0.165	0.054	
1,2,3,7,8-PeCDD	0.5	31:30	0.383	0.067	J
1,2,3,4,7,8-HxCDD	0.1	33:40	0.813	0.14	M
1,2,3,6,7,8-HxCDD	0.1	33:43	1.48	0.14	M
1,2,3,7,8,9-HxCDD	0.1	33:52	2.89	0.14	M
1,2,3,4,6,7,8-HpCDD	0.01	35:24	62.6	2.0	
OCDD	0.001	36:59	1140	0.68	
2,3,7,8-TCDF	0.1	24:56	0.384	0.031	
1,2,3,7,8-PeCDF	0.05	30:22	0.170	0.040	J
2,3,4,7,8-PeCDF	0.5	31:14	0.153	0.036	M,J,B
1,2,3,4,7,8-HxCDF	0.1	33:12	<0.23	0.051	M,J,R
1,2,3,6,7,8-HxCDF	0.1	33:17	0.277	0.050	M,J
2,3,4,6,7,8-HxCDF	0.1	33:35	0.194	0.050	M,J
1,2,3,7,8,9-HxCDF	0.1	34:03	<0.084	0.063	M,J,R
1,2,3,4,6,7,8-HpCDF	0.01	34:50	2.26	0.061	
1,2,3,4,7,8,9-HpCDF	0.01	35:42	<0.24	0.094	J,R
OCDF	0.001	37:07	6.65	0.16	

J - ICAL
J - Q
J - Q

J - ICAL
J - ICAL, Q
R - ICAL, TUN, Q
J - ICAL, Q
R - ICAL, TUN, Q
R - ICAL, TUN

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:06	70	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:29	71	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:40	87	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:42	79	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:23	66	23-140
13C12-OCDD	4000	36:59	52	17-157
13C12-2,3,7,8-TCDF	2000	24:55	71	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:21	69	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:13	71	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:12	84	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:16	78	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:35	79	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:02	76	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:49	69	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:41	61	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:08	70	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	11	14.5	0.054
Total-PeCDD	6	18.0	0.067
Total-HxCDD	7	100	0.14
Total-HpCDD	2	249	2.0
Total-TCDF	11	2.13	0.031
Total-PeCDF	5	1.07	0.040
Total-HxCDF	7	2.07	0.063
Total-HpCDF	3	4.72	0.094

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~2.84~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	2.87
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~2.87~~

J ΣCS

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated
J	Indicates that a target analyte was detected below the calibrated range
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-03B (HSC6-100709-001)**	Sampling Date	7-Oct-09		Approved:
ALS Sample ID	L830159-2	Extraction Date	22-Oct-09		*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	12.45	grams	---e-signature---
Analysis Type	Sample	Percent Moisture	38.6%		06-Nov-09
Sample Matrix	SEDIMENT	Split Ratio	1		

Run Information	**Run 1**
Filename	1-091102A-12
Run Date	03-Nov-09 00:03
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5ms #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	NotFnd	<0.13	0.13	U
1,2,3,7,8-PeCDD	0.5	31:30	0.235	0.060	J-ICAL
1,2,3,4,7,8-HxCDD	0.1	33:41	0.536	0.25	J-ICAL
1,2,3,6,7,8-HxCDD	0.1	33:43	1.06	0.27	
1,2,3,7,8,9-HxCDD	0.1	33:52	2.51	0.26	
1,2,3,4,6,7,8-HpCDD	0.01	35:24	69.9	1.6	
OCDD	0.001	36:59	1870	0.60	
2,3,7,8-TCDF	0.1	24:58	0.161	0.067	M
1,2,3,7,8-PeCDF	0.05	30:23	0.0953	0.048	J
2,3,4,7,8-PeCDF	0.5	31:15	0.0951	0.044	J,B
1,2,3,4,7,8-HxCDF	0.1	33:13	<0.14	0.031	M,J,R
1,2,3,6,7,8-HxCDF	0.1	33:18	0.120	0.030	M,J
2,3,4,6,7,8-HxCDF	0.1	33:36	0.106	0.032	M,J
1,2,3,7,8,9-HxCDF	0.1	34:03	<0.046	0.039	M,J,R
1,2,3,4,6,7,8-HpCDF	0.01	34:50	1.13	0.063	
1,2,3,4,7,8,9-HpCDF	0.01	35:41	<0.11	0.10	J,R
OCDF	0.001	37:07	3.11	0.22	

J-Q
J-ICAL
J-ICAL
R-ICAL, TUN, Q
J-ICAL, Q
J-ICAL, Q
R-ICAL, TUN, Q
R-ICAL TUN

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:08	78	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:29	70	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:40	80	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:43	79	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:23	58	23-140
13C12-OCDD	4000	36:59	44	17-157
13C12-2,3,7,8-TCDF	2000	24:56	81	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:22	69	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:14	70	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:13	80	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:17	79	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:35	75	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:03	76	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:50	67	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:41	57	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:10	81	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	7	20.1	0.13
Total-PeCDD	8	31.5	0.060
Total-HxCDD	7	218	0.27
Total-HpCDD	2	483	1.6
Total-TCDF	7	0.678	0.067
Total-PeCDF	5	0.556	0.048
Total-HxCDF	5	0.913	0.039
Total-HpCDF	2	1.46	0.10

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~3.20~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	3.29
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~3.35~~

J ECS.

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated
U	Indicates that this compound was not detected above the MDL.
J	Indicates that a target analyte was detected below the calibrated range
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-04B (HSC7-100709-001)**	Sampling Date	7-Oct-09	Approved:
ALS Sample ID	L830159-3	Extraction Date	22-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	18.1 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	12.8%	06-Nov-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091103A-04
Run Date	03-Nov-09 12:26
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5ms #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	NotFnd	<0.026	0.026	U
1,2,3,7,8-PeCDD	0.5	31:31	0.0500	0.017	M,J
1,2,3,4,7,8-HxCDD	0.1	33:41	0.0762	0.023	M,J
1,2,3,6,7,8-HxCDD	0.1	33:44	0.0853	0.023	M,J
1,2,3,7,8,9-HxCDD	0.1	33:53	0.226	0.023	M,J
1,2,3,4,6,7,8-HpCDD	0.01	35:25	3.08	0.14	
OCDD	0.001	37:00	61.7	0.17	
2,3,7,8-TCDF	0.1	24:59	0.0536	0.018	J
1,2,3,7,8-PeCDF	0.05	30:24	0.0300	0.017	J
2,3,4,7,8-PeCDF	0.5	31:16	<0.045	0.015	J,R
1,2,3,4,7,8-HxCDF	0.1	33:14	<0.031	0.017	J,R
1,2,3,6,7,8-HxCDF	0.1	33:18	<0.028	0.017	J,R
2,3,4,6,7,8-HxCDF	0.1	33:37	0.0471	0.017	J
1,2,3,7,8,9-HxCDF	0.1	34:04	0.0274	0.020	J
1,2,3,4,6,7,8-HpCDF	0.01	34:52	<0.12	0.019	J,R
1,2,3,4,7,8,9-HpCDF	0.01	35:42	<0.042	0.030	J,R
OCDF	0.001	37:08	0.428	0.063	J

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:09	64	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:30	61	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:40	66	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:44	78	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:24	61	23-140
13C12-OCDD	4000	37:00	42	17-157
13C12-2,3,7,8-TCDF	2000	24:57	68	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:23	61	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:15	62	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:13	73	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:18	75	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:36	73	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:04	74	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:51	69	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:42	60	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:11	65	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	4	0.706	0.026
Total-PeCDD	4	1.07	0.017
Total-HxCDD	9	7.38	0.023
Total-HpCDD	2	13.8	0.14
Total-TCDF	3	0.111	0.018
Total-PeCDF	1	0.0300	0.017
Total-HxCDF	2	0.0745	0.020
Total-HpCDF	2	0.107	0.030

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~0.171~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	0.214
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~0.227~~

J ECS

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated
U	Indicates that this compound was not detected above the MDL.
J	Indicates that a target analyte was detected below the calibrated range
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-05B (0051-100709-001)**	Sampling Date	7-Oct-09	Approved:	
ALS Sample ID	L830159-4	Extraction Date	22-Oct-09	*B. Reimer*	
Analysis Method	EPA 1613B	Sample Size	8.48 grams	--e-signature--	
Analysis Type	Sample	Percent Moisture	58.7%	06-Nov-09	
Sample Matrix	SEDIMENT	Split Ratio	1		

Run Information	**Run 1**
Filename	1-091103A-05
Run Date	03-Nov-09 13:09
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5ms #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:12	0.258	0.067	
1,2,3,7,8-PeCDD	0.5	31:30	0.491	0.12	J
1,2,3,4,7,8-HxCDD	0.1	33:40	1.54	0.30	M
1,2,3,6,7,8-HxCDD	0.1	33:43	2.32	0.31	M
1,2,3,7,8,9-HxCDD	0.1	33:52	4.24	0.31	M
1,2,3,4,6,7,8-HpCDD	0.01	35:24	116	2.5	
OCDD	0.001	37:00	2330	0.37	
2,3,7,8-TCDF	0.1	24:59	0.624	0.069	
1,2,3,7,8-PeCDF	0.05	30:23	0.363	0.076	J
2,3,4,7,8-PeCDF	0.5	31:15	0.366	0.073	J,B
1,2,3,4,7,8-HxCDF	0.1	33:13	0.931	0.046	J
1,2,3,6,7,8-HxCDF	0.1	33:17	0.689	0.045	J
2,3,4,6,7,8-HxCDF	0.1	33:36	0.544	0.047	J
1,2,3,7,8,9-HxCDF	0.1	34:04	0.182	0.054	J
1,2,3,4,6,7,8-HpCDF	0.01	34:50	5.89	0.12	
1,2,3,4,7,8,9-HpCDF	0.01	35:42	<0.55	0.18	M,J,R
OCDF	0.001	37:07	15.9	0.19	

J-ICAL
J-Q
J-Q
J-Q

J-ICAL
J-ICAL
J-ICAL
J-ICAL
J-ICAL
J-ICAL
R-ICAL, TUN Q

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:09	73	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:29	65	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:40	70	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:43	82	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:24	57	23-140
13C12-OCDD	4000	36:59	49	17-157
13C12-2,3,7,8-TCDF	2000	24:57	77	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:22	66	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:14	66	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:12	78	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:17	79	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:35	75	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:03	78	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:49	62	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:42	55	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:11	73	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	11	23.7	0.067
Total-PeCDD	8	33.3	0.12
Total-HxCDD	8	170	0.31
Total-HpCDD	2	484	2.5
Total-TCDF	9	3.81	0.069
Total-PeCDF	6	2.68	0.076
Total-HxCDF	8	7.07	0.054
Total-HpCDF	2	12.2	0.18

Toxic Equivalency - NATO	**pg/g**
Lower Bound PCDD/F TEQ (ND=0)	5.38
Mid Bound PCDD/F TEQ (ND=0.5DL)	5.38
Upper Bound PCDD/F TEQ (ND=DL)	5.38

J ECS

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalenc
M Indicates that a peak has been manually integrated

J Indicates that a target analyte was detected below the calibrated range
R Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion
B Indicates that this target was detected in the blank at greater than 10% of the sample concentration

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-06A (EB1-100709-002)**	Sampling Date	7-Oct-09	Approved:
ALS Sample ID	L830159-5	Extraction Date	20-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	0.96 Litres	--e-signature--
Analysis Type	Sample	Percent Moisture	n/a	06-Nov-09
Sample Matrix	WATER	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091102A-09
Run Date	02-Nov-09 21:55
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/L
Instrument - Column	HRMS-1 DB5ms #USB745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/L**	**EDL pg/L**	**Flags**
2,3,7,8-TCDD	1	NotFnd	<0.55	0.55	U
1,2,3,7,8-PeCDD	0.5	NotFnd	<0.73	0.73	U
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.80	0.80	U
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.85	0.85	U
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.84	0.84	U
1,2,3,4,6,7,8-HpCDD	0.01	35:24	<2.4	1.4	J,R
OCDD	0.001	36:59	<6.9	4.4	J,R
2,3,7,8-TCDF	0.1	NotFnd	<0.46	0.46	U
1,2,3,7,8-PeCDF	0.05	NotFnd	<0.54	0.54	U
2,3,4,7,8-PeCDF	0.5	NotFnd	<0.54	0.54	U
1,2,3,4,7,8-HxCDF	0.1	33:13	<0.49	0.46	J,R
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.44	0.44	U
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.50	0.50	U
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<0.63	0.63	U
1,2,3,4,6,7,8-HpCDF	0.01	34:50	1.03	0.96	M,J
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<1.6	1.6	U
OCDF	0.001	NotFnd	<2.7	2.7	U

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R - 1 CAL, TUN
R - 1 CAL, TUN
J - 1 CAL, Q

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:06	47	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:28	42	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:39	53	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:42	52	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:23	43	23-140
13C12-OCDD	4000	36:59	33	17-157
13C12-2,3,7,8-TCDF	2000	24:54	44	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:22	40	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:14	38	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:12	52	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:16	51	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:34	48	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:02	47	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:49	44	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:41	37	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:08	60	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/L**	**EDL pg/L**
Total-TCDD	0	<0.55	0.55
Total-PeCDD	0	<0.73	0.73
Total-HxCDD	0	<0.85	0.85
Total-HpCDD	0	<1.4	1.4
Total-TCDF	0	<0.46	0.46
Total-PeCDF	0	<0.54	0.54
Total-HxCDF	0	<0.63	0.63
Total-HpCDF	0	<1.6	1.6

Toxic Equivalency - NATO	**pg/L**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~0.0103~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	0.932
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~1.77~~

J EC S

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated
U	Indicates that this compound was not detected above the MDL.
J	Indicates that a target analyte was detected below the calibrated range
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion

ALS Laboratory Group

Sample Analysis Report

Sample Name	**0910215-07B (DUPLICATE)**	Sampling Date	7-Oct-09	Approved:
ALS Sample ID	L830159-7	Extraction Date	22-Oct-09	*B. Reimer*
Analysis Method	EPA 1613B	Sample Size	11.42 grams	--e-signature--
Analysis Type	Sample	Percent Moisture	45.4%	06-Nov-09
Sample Matrix	SEDIMENT	Split Ratio	1	

Run Information	**Run 1**
Filename	1-091103A-07
Run Date	03-Nov-09 14:34
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg/g
Instrument - Column	HRMS-1 DB5ms #US8745224H

Target Analytes	**TEF NATO**	**Ret. Time**	**Conc. pg/g**	**EDL pg/g**	**Flags**
2,3,7,8-TCDD	1	26:09	0.336	0.046	
1,2,3,7,8-PeCDD	0.5	31:30	0.507	0.051	J - ICAL
1,2,3,4,7,8-HxCDD	0.1	33:40	1.13	0.22	
1,2,3,6,7,8-HxCDD	0.1	33:44	2.10	0.22	
1,2,3,7,8,9-HxCDD	0.1	33:52	3.91	0.22	J - Q
1,2,3,4,6,7,8-HpCDD	0.01	35:24	87.6	2.3	
OCDD	0.001	36:59	1660	0.73	
2,3,7,8-TCDF	0.1	24:57	0.616	0.041	
1,2,3,7,8-PeCDF	0.05	30:23	0.262	0.043	J - ICAL
2,3,4,7,8-PeCDF	0.5	31:15	<0.23	0.041	J,R R - ICAL, TUN
1,2,3,4,7,8-HxCDF	0.1	33:13	0.470	0.038	M,J J - ICAL, Q
1,2,3,6,7,8-HxCDF	0.1	33:17	0.380	0.036	M,J J - ICAL, Q
2,3,4,6,7,8-HxCDF	0.1	33:36	0.325	0.039	J J - ICAL, Q
1,2,3,7,8,9-HxCDF	0.1	34:04	<0.12	0.045	M,J,R R - ICAL, Q, TUN
1,2,3,4,6,7,8-HpCDF	0.01	34:50	3.47	0.11	
1,2,3,4,7,8,9-HpCDF	0.01	35:42	<0.34	0.15	J,R R - ICAL, TUN
OCDF	0.001	37:07	12.5	0.12	

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26:07	69	25-164
13C12-1,2,3,7,8-PeCDD	2000	31:29	67	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33:40	83	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33:43	75	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35:23	58	23-140
13C12-OCDD	4000	36:59	50	17-157
13C12-2,3,7,8-TCDF	2000	24:56	77	24-169
13C12-1,2,3,7,8-PeCDF	2000	30:22	69	24-185
13C12-2,3,4,7,8-PeCDF	2000	31:14	67	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33:13	85	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33:17	80	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33:35	78	29-147
13C12-1,2,3,7,8,9-HxCDF	2000	34:03	81	28-136
13C12-1,2,3,4,6,7,8-HpCDF	2000	34:50	67	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35:41	65	26-138

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD	40	26:09	70	35-197

Homologue Group Totals	**# peaks**	**Conc. pg/g**	**EDL pg/g**
Total-TCDD	11	16.7	0.046
Total-PeCDD	9	25.1	0.051
Total-HxCDD	8	131	0.22
Total-HpCDD	2	357	2.3
Total-TCDF	11	3.38	0.041
Total-PeCDF	7	2.44	0.043
Total-HxCDF	7	3.84	0.045
Total-HpCDF	3	7.20	0.15

Toxic Equivalency - NATO	**pg/g**
~~Lower Bound PCDD/F TEQ (ND=0)~~	~~4.09~~
Mid Bound PCDD/F TEQ (ND=0.5DL)	4.21
~~Upper Bound PCDD/F TEQ (ND=DL)~~	~~4.21~~

J ECS

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated
J	Indicates that a target analyte was detected below the calibrated range
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion

Appendix D